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This Issue Contains

Outstanding 1950 Annual Meeting; Technical Sessions; Committee Meetings; Apparatus and Photographic Exhibits; Honorary Members; Awards of Merit; New Officers.....	5-38
New and Revised Tentatives with Serial Designations.....	21
Annual Address by the President, J. G. Morrow.....	55
Stress Cracking of Polyethylene, by R. H. Carey.....	56
Resistance of Representative Plastic Materials to Hydrofluoric Acid, by Frank W. Reinhardt and Harry C. Williams, Jr.....	60
A Suggested Relocation and Respacing of the Union Colorimeter Scale for Lubricating Oil and Petroleum, by Deane B. Judd, Lorenzo Plaza, and Marion A. Belknap.....	63
X-ray Methods in the Analysis and Preparation of Leaded Gasoline, by H. A. Liebfafsky and E. H. Winslow.....	67
Discussion of Paper on Some Applications of Modern Microscopy to the Study of Chemical Phenomena and in the Dyeing and Printing of Textiles.....	73
Dimensional Stability of Woolen and Worsted Fabrics, by Werner von Bergen and Claude S. Clutz.....	74
Shrinkage Control of Viscose Rayon Fabrics, by J. A. Woodruff.....	83
The Dimensional Stability and Shrink-Proofing of Cotton Materials, by Edward C. Pfeffer, Jr.....	86
Methods of Evaluating Aircraft Primers, by Edward T. Nelson.....	88

NEWS ABOUT THE SOCIETY AND ITS COMMITTEES:

Technical Committee Notes.....	27-38
Meetings of Technical Committees and Notes.....	47-50
New Publications.....	39, 40
Schedule of A.S.T.M. Meetings....	40
Shall We Change Method of Acting on Standards.....	41
Status of Pacific Area Papers.....	43
New District Officers and Personnel; District Meetings.....	44-47
New Committee on Atmospheric Pollution; X-Ray Diffraction Data	47
Sustaining Members; National Meetings.....	50
Personals; New Members; Necrology.....	51-54

MISCELLANEOUS NEWS NOTES:

Book Reviews and Notes on Literature: Manual of Open-Die Forgings; Bricklayers' Manual; Acoustical Designing; Sound Absorbing Materials.....	42, 93
Index to Advertisers.....	107

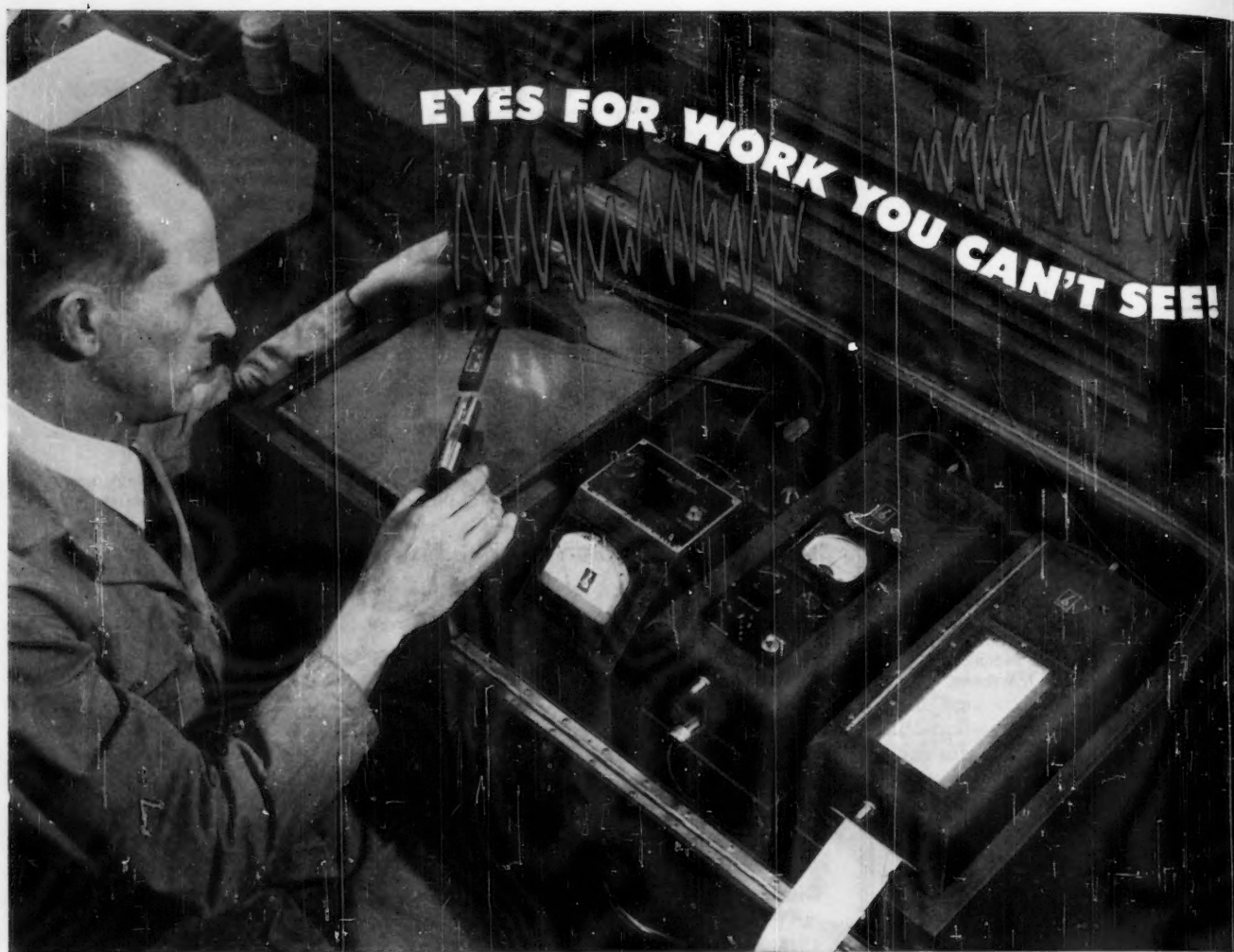
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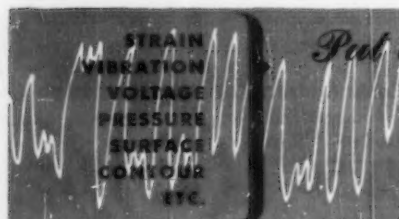
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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

TELEPHONE—Rittenhouse 6-5315

R. E. Hess, Editor
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CABLE ADDRESS—TESTING, Philadelphia

Number 167

JULY, 1950

Outstanding 1950 Annual Meeting

Record-Breaking Attendance, 500 Committee Meetings, Interesting Exhibits

VARIOUS factors influence the attendance at an annual meeting of the Society. The nature of the technical program, the number of committee meetings, whether or not there are exhibits—all these and other activities may or may not draw technical men from various industries.

The record-breaking registered attendance at the 1950 Annual Meeting, totaling 2131, with hundreds of others present visiting the exhibit and attending some of the sessions, can be attributed to the combined effect of the some 500 technical committee meetings, the notable technical sessions, particularly strong in the metals fields this year, and the apparatus and photographic exhibits. Data on attendance figures are given later in this article.

In the material which follows, an attempt is made briefly to note some of the high lights of the meeting. There

is condensed news on various technical sessions with specific references to certain papers, and following this are notes on some of the technical committee activities as prepared by technical men on the Staff. It should be emphasized that this material is definitely of a news nature, and anyone wishing to determine the action on a specific standard or to have a detailed list of the actions at specific sessions, should consult the *Summary of Proceedings* which will be mailed to each member of the Society in August. This Summary, together with the preprinted reports of the technical committees which each member could request, provide full information on the business at the meeting and further, give each member sufficient information so that if he wishes he can vote on the items on the Standards Letter Ballot that will be mailed with the *Summary of Proceedings*.

ing will eventually be published in the 1950 Supplement to the Book of Standards. There will be a Supplement to each Part of the Book, and these will appear in the winter of 1950-1951. In the meantime, many of the specifications and tests will appear in the special compilations of standards on which work is under way. Many of these compilations, for example, those on petroleum, textiles, and others, will be issued in the fall, and a determined effort is made to issue separates of the standards as soon as possible. All of the new tentatives were preprinted in the respective committee reports, and it is presumed the members particularly interested have requested copies of these reports.

Attendance

The registered attendance at the meeting, 2131, is a new high, exceeding the previous high at New York City in

New President



L. J. Markwardt

Standardization Accomplishments

The accompanying summary table of actions taken at the Annual Meeting affecting standards and tentatives should give at least some idea of the work which has been accomplished.

Approval of 62 new tentatives representing the "new" work, 62 approvals representing adoptions of tentatives as standard, and numerous revisions of standards and tentatives as indicated by the table all indicate the intensive activity of the various technical committees.

In a separate article in this BULLETIN there is a complete list of the *new* and *extensively revised* tentative specifications and tests. Many members are interested especially in the serial designations that have been assigned.

Standards Published.—All of the new and revised standards acted on at the meet-

New Vice-President



T. S. Fuller

1944. The 1949 meeting in Atlantic City had the third highest number. Details are given in the accompanying table. Most of the technical committee meetings were well attended, and some in the ferrous metals field had a notable number present. Interest in subjects covered at the technical sessions, in particular those involving metals at elevated temperatures, nondestructive testing, and soils testing was indicated by the large attendance. Some of the later sessions, devoted primarily to the presentation of committee reports had a very meager attendance. This situation lends particular significance to the proposal published in the April ASTM BULLETIN and reprinted in this issue, involving the appointment of Review Panels to approve actions at the Annual Meeting proposed by the technical committees, instead of taking action at a regular session.

New Officers

Results of the letter ballot on election of new officers were announced at the Tuesday Luncheon Session by the Chairman of the Tellers' Committee, Henry Grinsfelder. The newly elected members of the Board of Directors who were present were introduced, as was the new President, L. J. Markwardt, U. S. Forest Products Laboratory, who spoke briefly. The new Vice-President, Truman S. Fuller, General Electric Co., was introduced. Photographs of the new officers and biographical material appear elsewhere in this BULLETIN.

Annual Dinner: Ladies' Entertainment

The 1950 Annual Dinner, this year held in the Chalfonte on Wednesday evening, was very well attended, and the entertainment program which followed

REGISTRATION—ANNUAL MEETINGS

	YEAR	MEMBERS	COMMITTEE MEMBERS	VISITORS	TOTAL	LADIES
Atlantic City.....	1942	835	264	275	1374	219
New York.....	1944	1185	368	510	2063	30 to 40
Buffalo.....	1946	978	405	452	1835	About 100
Atlantic City.....	1947	1071	469	246	1786	320
Detroit.....	1948	1160	358	250	1768	133
Atlantic City.....	1949	1092	530	235	1857	335
Atlantic City.....	1950	1160	637	334	2131	408

provided several outstanding acts. Following somewhat the pattern set in 1949, and again sponsored by the Philadelphia District, the dinner was purely a social event with no business functions or addresses. The costs of the entertainment were underwritten entirely through a special fund raised by the Philadelphia District. Reference is made on another page to the personnel who handled dinner details and other entertainment events.

Ladies Entertainment.—Over 400 ladies who attended the meeting with their husbands or families enjoyed another entertaining program of events as developed by the Philadelphia District which made plans in conjunction with a Hostess Committee consisting of wives of the Philadelphia Council members. Because of the interest in and demand for a look into the future, the committee this year had not one but three palmists at the informal tea. The game night was the usual interesting affair with prizes and refreshments, and a number of the ladies took the tour of the Haddon Hall kitchens and other facilities. Thursday afternoon, Mrs. Eleanor P. Whitaker, of the Du Pont Company, gave a most interesting lecture on "The Importance of Man-Made Textile Fibers to Fashion." Many of the ladies also attended the two Society Luncheon Sessions, and the dinner.

Awards

The various awards in recognition of outstanding technical papers, including the Charles B. Dudley Medal, the Richard L. Templin and the Sam Tour Awards, were made at the Tuesday night session just preceding the Edgar Marburg Lecture. The award winners are as follows (further biographical material appears on a later page of this BULLETIN):

The Twenty-second Award of the Charles B. Dudley Medal went to B. J. Lazan, Professor and Head, Department of Materials Engineering, Syracuse University, Syracuse, N. Y., for his paper on "Dynamic Creep and Rupture Properties of Temperature-Resistant Materials Under Tensile Fatigue Stress," published in the 1949 *Proceedings*.

The Fifth Richard L. Templin Award was made to D. S. Clark and D. S. Wood, Associate Professor of Mechanical Engineering and Research Assistant, respectively, California Institute of Technology, Pasadena, Calif., for their paper on "The Time Delay for the Initiation of Plastic Deformation at Rapidly Applied Constant Stress," published in the 1949 *Proceedings*.

The Second Sam Tour Award was made to O. B. Ellis, Senior Research Engineer, Research Laboratories, Armco



This group includes some of the new and previously elected Honorory Members, Past-Presidents, and former and current officers of the Society.



A group of ladies attending the Annual Meeting. This picture was taken following the Sunday evening buffet supper for the officers and their wives and members of their families.

Steel Corp., Middletown, Ohio, for his paper on "Effect of Weather on the Initial Corrosion Rate of Sheet Zinc," published in the 1949 *Proceedings*.

Notes on Some of the Sessions

Corrosion and Erosion of Gas Turbine Materials

A symposium, sponsored by the Joint Committee on Effect of Temperature on the Properties of Metals, was presented at the opening session of the Annual Meeting, and the attendance of about 250 augured well for the sessions to follow. This was one of the very interesting sessions at the meeting, of particular concern to not only those who build and use gas turbines but suppliers including the industries providing fuels. Arranged by C. T. Evans, Jr., Chief Metallurgist, Elliott Co., who is also Chairman of the sponsoring Gas Turbine Panel of the Joint Committee on Effect of Temperature, there were seven formal papers and an oral presentation plus considerable discussion. Mr. Evans himself had two papers, one covering

coal-ash corrosion of metals, the other oil-ash corrosion. The succinct conclusion to the coal-ash paper was that under the conditions of the tests, which were stress-rupture tests run on specimens coated with separated coal ash, and on specimens in contact with raw ash, the ash was inert with respect to the S-588 alloy and several other metals of interest to builders of gas turbines for coal-burning service.

The paper on oil-ash corrosion shed considerable light on this problem. It is known that ash from residual fuel oils can be highly corrosive to materials at elevated temperatures, particularly where there are substantial quantities of vanadium in the ash.

An oil ash from domestic crude oils containing approximately 6.0 per cent vanadium, 5.0 per cent sodium, and 10.0 per cent sulfur was corrosive to S-588 heat-resisting alloy in stress-to-rupture tests at 1350 F. The heaviest corrosion occurred above the line of ash contact. 19-9DL alloy was not so heavily attacked by this ash.

On the other hand, domestic ash containing approximately 3.0 per cent vanadium, 1.0 per cent sodium, and 8.0 per cent sulfur was not corrosive to either of these

alloys, or to a wide selection of heat-resisting materials, in unstressed tests at temperatures of 1000, 1350, or 1500 F. The unstressed tests were run with only about one half of each specimen underneath the ash.

Two ashes from Venezuelan crude oils and one ash from Middle East crude oil were compared with nine representative metals at 1000, 1200, and 1350 F. A liquid phase was observed in all three ashes at 1000 F., and slight attack occurred on all the alloys at 1000 and 1200 F. At 1350 F. these ashes are liquid, and heavy attack occurs, either above or below the ash line or both. In many cases, "catastrophic oxidation" was observed.

One of the Venezuelan ashes with approximately 44.5 per cent vanadium, 2.0 per cent sodium, and 3.0 per cent sulfur was selected for "screening" tests on over 80 different materials or protective treatments. The tests were run for 168 hr. at 1350 F. The "superalloys" had the poorest corrosion resistance, while the relatively weak low-nickel or nickel-free alloys had the best. Ordinary "18-8" stainless steel had the best resistance in the austenitic or "superalloy" class. Several ceramics were also severely attacked.

Of the protective coating processes, "Thrigizing" was the best for carbon steel, and "chromizing" was also effective in

SUMMARY OF ACTIONS TAKEN AT ANNUAL MEETING AFFECTING STANDARDS AND TENTATIVES.

	Existing Tentatives Adopted as Standard	Standards in Which Revisions Will Be Adopted	New Tentatives	New Standards	Revision of Standard and Reversion to Tentative	Tentative Revisions of Standards	Existing Tentatives Revised	Standards and Tentatives Withdrawn	Present Total Standards Adopted	Present Total Tentatives
A. Ferrous Metals—Steel, Cast Iron, Wrought Iron, Alloys, etc.	2	10	4	0	0	0	23	0	123	112
B. Non-Ferrous Metals—Copper, Zinc, Lead Aluminum, Alloys, etc.	14	12	2	0	0	0	30	0	102	97
C. Cement Lime, Gypsum, Concrete and Clay Products.	2	20	2	0	0	0	1	2	157	49
D. Paints, Petroleum Products, Bituminous Materials, Paper, Textiles, Plastics, Rubber, Soap, Water, etc.	43	43	53	1	2	9	51	6	547	353
E. Miscellaneous Subjects, Testing, etc.	1	5	1	0	1	2	2	3	42	40
Total	62	90	62	1	3	11	107	11	971	651

protecting carbon steel and type 430 stainless steel. "Siliconizing" reduced the amount of attack on some of the superalloys. Metallizing with aluminum appeared to have promise in protecting "18-8."

However, when some of the better materials or protective coatings were tested for a longer time at 1350 F., or at 1500 F., heavy attack occurred.

In a study of the effects of various percentages of vanadium pentoxide in sodium sulfate on the corrosion of "18-8" at 1350 F., it was found that no corrosion occurred at 2 per cent or less of vanadium pentoxide. This coincided with the percentage at which the mixture has no liquid component at 1350 F.

The Venezuelan ash did not corrode any of the stainless or heat-resisting alloys in outdoor exposure tests for over seven months.

It was determined that the attack of hot oil ash on metals is confined to the surface, with the exception of high-nickel alloys, like Inconel, where intergranular penetration was observed. It is not necessary for the material to be in contact with the ash in order to experience severe corrosion.

It is concluded that no straightforward metallurgical solution is in sight which can be expected to take care of the more severe cases of oil ash corrosion of materials at elevated temperatures. The use of additives in the oil is suggested as a promising approach to an over-all solution of this problem. Lime (CaO) is the most promising of the additives which have been investigated.

G. B. Wilkes, Jr., of General Electric Co., described stress-corrosion tests made on 18 alloys where the corroding agents were the products of combustion of leaded aircraft gasoline. Tests were made under both constant temperature and cyclic temperature conditions. Under the conditions of these tests, the combustion products are somewhat corrosive if the temperature is cycled and not constant. The acceleration of strain due to temperature cycling alone has a greater detrimental effect on strength.

Messrs. Pickus and Parker covered creep as a surface dependent phenomenon, stating that perhaps the most significant conclusions to be drawn are the facts that, under certain conditions at least, creep is a surface dependent phenomenon, and that effects such as those reported for single crystals of metals like zinc, cadmium and tin may occur in polycrystalline high-temperature metals, such as nickel.

Shepard and Schalliol, of Stanford University, gave a paper on the effect of environment on the stress-rupture properties of metals at elevated temperatures.

Talbot and Skinner, of the International Nickel Co., concluded from preliminary studies of the effect of oxidizing sulfurous atmospheres on the rupture strengths of Inconel "X" and Inconel, that the present limited data should not be construed as a tacit recommendation that high-nickel alloys may be safely used in certain sulfurous atmospheres at elevated temperatures; they do, however, indicate that there is probably a limiting sulfur concentration (as yet undetermined) within which alloys of this type may be relatively unaffected by prolonged high-temperature exposure even in the presence of stress.

It is expected that this symposium will be available later in the Summer or early Fall. It will be of outstanding interest to technologists and various industries.

Effect of Sigma Phase on the High-Temperature Properties of Metals

The short introduction to the two-session Symposium on Sigma Phase held at the Annual Meeting indicated that it is a "somewhat baffling, not well-understood constituent of many of our heat-resistant alloys." Nevertheless, it is apparent from the eleven technical papers in the symposium that from the intensive research work under way there is developing a growing knowledge and information of many aspects of the sigma phase.

It was the purpose of this symposium—arranged by the research panel of the Joint Committee on Effect of Temperature and largely "spark plugged" by Francis B. Foley, Vice-Chairman of the Joint Committee who has done a great deal to focus attention on this problem—to provide a forum so that those concerned and who have work under way might exchange much of their knowledge. Unquestionably the symposium accomplished this, and anyone concerned with the use of steels and alloys at high temperature will find in these papers much help. It is expected that eventually these papers will be issued as a special publication.

E. J. Dulis and G. V. Smith, in describing the identification and mode of formation, point out that commercial austenitic stainless steels undergo microstructural changes and that the precipitation of the sigma phase is one of the most interesting of such changes. They describe this phase as a hard, brittle, nonmagnetic solid solution of complex crystal structure based upon the compound FeCr and occurring at temperatures below 1700 F., depending upon composition. In alloys so balanced in composition that they contain no high-temperature ferrite (delta fer-

rite), the precipitation of sigma is quite sluggish, being encountered only after prolonged exposure at elevated temperature. But in alloys that are predominantly austenitic, though containing some ferrite, sigma may form during ordinary commercial heat treatments.

The authors described a most comprehensive series of investigations, and as a result of X-ray diffraction and magnetic permeability studies they suggested procedures by which the sigma, carbide, and ferrite phases can be differentiated. Their work involved a study of most of the etching reagents recommended for stainless materials.

V. T. Malcolm and S. Low in describing sigma in cast steels point out that although the embrittling effect of sigma phase in cast austenitic steels is quite pronounced after long-time exposure above 1200 F., it should be borne in mind that this effect is more pronounced when measured at room temperature. Even so, the resulting impact strengths equal, or exceed, the impact values for low-alloy ferritic materials currently operated to 1050 F. in steam service. They note that this embrittling effect of sigma phase is not a metallurgical problem alone. If the mechanical engineer insists that the entire problem is one that requires the metallurgist to devise a sigma-free (or more properly an embrittlement free) steel rather than recognizing that the effect of sigma is also a design problem, we can hope for little progress in this field.

X-ray studies of sigma phase were described by Pol Duwez and S. R. Baen and they suggest a tentative tetragonal unit cell to describe the structure.

Experiments reported by Putman, Grant, and Bloom on the sigma phase in chromium-molybdenum alloys led to the conclusion that molybdenum increases the high-temperature stability of sigma in iron-chromium alloys, and that the sigma phase in the 60Cr-25Mo-15Fe alloy is stable at 1100 C. With regard to this alloy, the temperature effect is such that at lower temperatures the tendency for the formation of sigma is increased, provided that sufficient time be allowed for the transformation.

The sigma phase has been found to occur in the chromium-molybdenum-nickel ternary alloys, although its occurrence has not been reported in any of the three constituent binaries. X-ray diffraction data on chromium-molybdenum-nickel sigma are included.

R. S. Stewart and S. F. Urban, in describing the sigma influence on stabilized 18Cr-8Ni steels in concentrated nitric acid, found that the presence of sigma phase, rather than chromium carbide

precipitation, is responsible for the low corrosion resistance of titanium stabilized austenitic stainless steels in boiling 65 per cent nitric acid, when tested after a "sensitizing" treatment. It was found that the quantity of sigma could be minimized by rather close control of the aluminum content and of the chromium and nickel contents. A slight increase in aluminum increases the amount of delta ferrite to a moderate degree, but markedly increases the amount of sigma phase transformed from the ferrite present when the steel is reheated for two hours at 1250 F.

The increasing use of welding in austenitic stainless steels focuses attention on effect of sigma in columbium-stabilized weldments. Among the conclusions in the paper on this subject by F. W. Schmitz and M. A. Scheil were the following:

Water quenching from 1950 F., following the holding at 1600 F. for two periods of 3 hr. duration and air cooling after each heating period resulted in the production of fair to excellent weld ductility. In these tests any of the brittle sigma phase that may have been formed disappeared after the 1950 F. heat treatment.

Welds stress-relieved at 1000 F. were given good to excellent ductility ratings. With no brittle sigma phase being formed at this temperature the ferrite content

after heat treatment was approximately the same as in the as-welded condition. Any difference in the percentage ferrite can only be attributed to the segregated agglomerate.

Welds held at 1600 F. for 8 hr. and air cooled directly to room temperature showed good to excellent ductility. In each case some of the sigma phase was present after heat treatment; however, in addition to the sigma phase there was contained in each weld 3 to 5 per cent of ferrite. This percentage of ferrite evidently tended to offset any harmful effects promoted by the sigma phase.

Even though the various heat treatments produced general ductility ratings of poor to excellent, the hardness of the welds was only slightly affected by these heat treatments.

J. H. Jackson as his contribution to the sigma "struggle" described its effect on properties of cast Fe-Ni-Cr alloys, particularly of the HH type (cast 26Cr-12Ni type). Alloys of this type may have lower creep properties and may be embrittled when appreciable quantities of the sigma phase are present. The detrimental effects increase with the amount of sigma produced in service or during testing. Means of avoiding sigma formation by composition control have been developed and are widely used by progressive foundries.

He stated that another alloy which is becoming more popular is the 26Cr-20Ni type which is less susceptible to the formation of sigma than the HH alloy.

J. J. Heger, of Carnegie-Illinois Steel, in a brief but significant paper described the formation of sigma in 17 per cent chromium steel. He stated that:

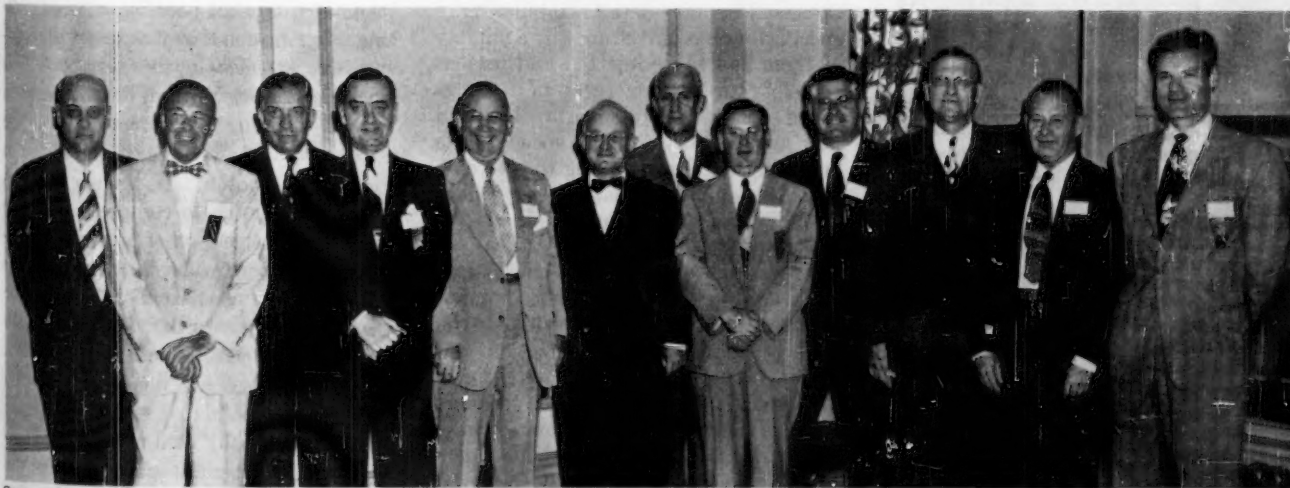
1. In 17 per cent chromium steel, sigma is a stable phase at temperatures below 1200 F.

Appreciation to Philadelphia District Council

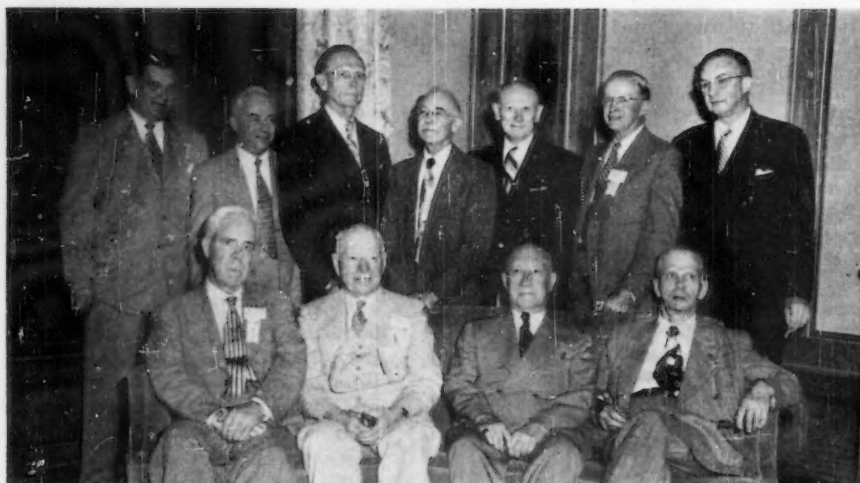
THIS was the second successive year that the Philadelphia District offered its services to the Board of Directors in planning for the Ladies' entertainment and other entertainment features of the meeting, including the dinner. The District also, through a special committee, arranged for the Photographic Exhibit. For the second year the District, through its Council, did an excellent job. While the chairmen of the various functions and the District Council officers bore the brunt of the numerous details to be handled, the entire Council participated and aided in other ways.

There is a separate article describing the Photographic Exhibit and listing the personnel of this committee. The thanks of all those at the meeting are tendered to the District for the features it arranged.

A Hostess Committee consisting of the wives of Council members functioned effectively in connection with the Ladies' entertainment. Special mention should be made of the help of Mrs. Howard Phelps, who assisted her husband as Chairman of the Ladies' Entertainment Committee, Mrs. Schaefer, Mrs. Spring, and others.



Some of the members of the Philadelphia District Council who acted as general hosts during the meeting and arranged the ladies' entertainment, the annual dinner and entertainment. From l. to r.: W. C. Clements, L. Drew Betz, H. M. Hancock, A. O. Schaefer, E. J. Albert, E. O. Hausmann, F. G. Tatnall, Tinius Olsen 2nd, H. W. Stuart, H. L. Maxwell, E. K. Spring, Henry Grinsfelder. Separately is Howard S. Phelps.



The President and some of his illustrious predecessors. Back row, from l. to r.: Past-Presidents J. R. Townsend, R. L. Templin, W. M. Barr, Dean Harvey, T. A. Boyd, H. H. Morgan, and K. G. Mackenzie. Front row, from l. to r.: Past-President A. E. White, President J. G. Morrow, Past-Presidents G. H. Clamer and T. G. Delbridge.

2. The present iron-rich boundaries of the alpha plus sigma region in the iron-chromium diagram must be shifted to lower chromium contents.

3. Cold work is a useful method for accelerating phase changes in those systems where solid state reactions occur at low rates.

Some notes on the structure and impact resistance of columbium-bearing 18-8 steels after exposure to elevated temperatures were presented by W. O. Binder. Among other points he noted that the most favorable temperature for sigma formation lies between 1110 and 1470 F., and the precipitation is increased by straining at elevated temperatures. Cold working, followed by low-temperature annealing, accelerates the formation of the phase and the growth of the precipitate, whereas high-temperature annealing renders the reaction more sluggish and inhibits precipitate growth. The precipitation of sigma phase in a critical particle size is believed to have a beneficial effect on creep strength, and the optimum temperature for sigma strengthening is about 1110 F. for type 347 stainless steel. This improvement is obtained without deleteriously changing other mechanical properties of the steel.

Committee A-10 on Sigma. In addition to the two-session symposium at the Annual Meeting, there was another "sigma" activity of considerable moment. This was the report of the extensive research carried out by the members of Subcommittee VI on Metallography of Committee A-10 on Iron-Chromium-Nickel and Related Alloys. Several extensive papers with many photomicrographs were reviewed at the meeting of this group.

While it is not probable that the symposium holds the last word on

sigma, certainly the published symposium will bring everyone concerned pretty much up to date and give one of the most comprehensive pictures of this elusive but very important constituent of heat-resisting alloys.

The two sessions were among the best attended at the Annual Meeting.

Round Table on Heavy Forgings

Arranged by the Gas Turbine Panel of the Joint Committee on Effect of Temperature through the efforts of the Panel Chairman, C. T. Evans, Jr., The Elliott Co., who presided at the session, the Round Table on Heavy Forgings was an all-morning affair with an excellent attendance of those concerned with the aggravating problems of providing the turbine manufacturer with parts that will operate efficiently at the high temperatures and stresses involved. A representative of one leading manufacturer discussed in some detail a tabulation of specific forgings indicating why a number of them had to be rejected and reasons therefor. A manufacturer of forgings noted some of the problems involved and how his company through special heats and practices is attempting to give consistently sound material. Other speakers discussed different methods of fabricating turbine parts.

There are really three different systems being used by leading gas turbine manufacturers to produce the essential parts. These were discussed.

While no commitments were made concerning publication and the speakers were advised that their remarks were "off the record," it is hoped that a correlated abstract of some of the material can be made available. Further announcement concerning this will be made.

Papers on Effect of Temperature

In addition to the two symposiums on Corrosion and Erosion of Gas Turbine Materials and Effect of Sigma Phase on the High-Temperature Properties of Metals, there was a separate session of seven papers involving various aspects of the effect of temperature on metals. In addition to this Ninth Session, there were also papers relating to the use of metals at elevated temperatures in the Fourteenth Session on Steel and Ferro Alloys, and the Non-Ferrous Metals Session on Thursday morning.

One of the papers was of a statistical nature involving the Interpretation of High-Temperature Data. The authors, Messrs. Cameron and Youden, Statistical Engineering Laboratory, National Bureau of Standards, had prepared this at the strong urging of the Joint Committee on Effect of Temperature because it was obvious to the Joint Committee that careful early planning of research work, whether of a joint nature or carried out in a single laboratory, could provide more significant data than if the tests were not so well planned in advance. The authors analyzed stress-rupture data on over 200 specimens of S-816 alloy. There was a variety of conditioning treatments. Perhaps a most pertinent portion of the paper is that which discusses the general problem of exploratory investigations with suggested ways and means of programming the work to facilitate statistical analysis.

Messrs. Jones and Wilkes, General Electric Co., in describing the Effect of Various Treatments on the Fatigue Strength of High-Temperature Alloys gave in their conclusions, certain corrective treatments where a part has to have a notch or stress raiser, particularly when it is subject to fatigue. The best way is cold working the surface of the notch by shot peening, coining, rolling, etc., in such a way as to set up compressive stresses in the surface. This increases the strength in its own right as well as helping to correct any tensile stresses that may have been produced in making the notch. If putting the surface of the notch in compression is not practical, a stress-relief anneal or complete heat treatment will remove a large part of any tensile stresses that may be present. If compressive stresses are present, the part should be annealed, as such stresses are beneficial. If the part in question is to operate at elevated temperatures, the gain realized by cold-working treatments becomes less as the temperature is increased, probably becoming negligible at the higher stress-relieving temperatures.

M. J. Manjoine of Westinghouse gave the results of an extensive series of creep and creep-rupture tests, high-speed impact tests, and others on ten alloys of interest to those designing and building high-temperature equipment such as gas turbines. Among other conclusions from the extensive data, the author noted that the shape of the stress-strain curve at extremely rapid rates of strain at 1200 and 1500 F. of these gas turbine alloys is similar to that at short-time tensile rates. In general, these materials strain harden nearly up to fracture, that is, the load increases with strain and the strain distribution is uniform practically up to fracture.

Chromium-Base Alloys were covered by Messrs. Havekotte, Greenidge, and Cross of Battelle Memorial Institute, in another extensive technical contribution. This research work was part of a Navy project on alloys and ceramics for high-temperature service which was aimed to procure chromium-base alloys with better properties than had developed from a very significant War Metallurgy Committee project in 1942 undertaken by Climax Molybdenum Co. The earlier work had shown that alloys ranging in composition between 60 per cent chromium, 15 per cent iron, 25 per cent molybdenum, and 60 per cent chromium, 25 per cent iron, and 15 per cent molybdenum, were the most promising for gas turbine blades. The current paper deals particularly with the 60Cr-15Fe-25Mo type alloy. While the authors point out that alloys melted in air give properties almost as good as the vacuum-melted alloys largely used in this work, John Pugh of General Electric advised that his experience in vacuum melting indicated that air melting might not be satisfactory. Since this alloy is susceptible to the formation of grinding cracks, care must be taken in this grinding. The alloy merits good oxidation-resistance rating at quite elevated temperatures in moist air and moist, low-oxygen atmospheres. Several chromium-base alloy specimens had rupture times in excess of 1000 hr. at 1600 F and 40,000 psi., and in excess of 100 hr. at 1800 F. and 25,000 psi.; these values are superior to the 1600- and 1800-F. rupture times for Stellite No. 31, one of the best cobalt-base alloys. The rupture times for chromium-base alloys at 1600 and 1800 F. increased with decreasing grain size. Chromium-base alloys, it was indicated, are sensitive to mechanical shock at room temperature as well as at temperatures up to 1800 F.

Papers by Ziegler and Brace of Westinghouse and Krivobok and Talbot of International Nickel Co. dealt with the effect of temperature on austenitic

stainless steels. The first-named paper concentrated on hardening of the steels by mechanical working at low temperatures. By plastic deformation at sub-zero temperatures, austenitic steels can be made unusually hard.

Messrs. Krivobok and Talbot confirmed that mechanical working at temperatures as low as -300 F. induced a much greater work of hardening with increased tensile and hardness properties. They noted that cold-rolled steels, whether worked at room or sub-zero temperatures, have better ductility at the lower temperatures than at room figures.

Steel Joining of Dissimilar Metals for High-Temperature Service

The Annual Meeting Session on Steel, Ferro Alloys, and Chemical Analysis was featured by two papers not preprinted, both from the Babcock & Wilcox Co., dealing with welding and joining of dissimilar metals. Messrs. Blasser, Eberle, and Tucker covered welds between dissimilar alloys in full size steam piping; and Messrs. Carpenter, Jessen, Wylie, and Oberg, in a very comprehensive and notable paper, described some considerations in the joining of dissimilar metals for high-temperature high-pressure service.

Messrs. Sinclair and Dolan in considering some effects of austenitic grain size and metallurgical structure on the mechanical properties of steel pointed out that austenitic grain size has little effect in the tempered martensitic steels but that in the ferritic steels it is of considerable moment. For example, a large increase in the prior austenitic grain size in pearlitic microstructure greatly reduced ductility.

While the paper on Rockwell C hardness testing on cylindrical steel specimens, by Hussey, will be of interest and help to those concerned with testing of curved surfaces, it is evident that a problem exists in connection with the $\frac{1}{4}$ -in. diameter material where the resulting curve did not follow the trend

of the others. Further work is to be done on this particular matter.

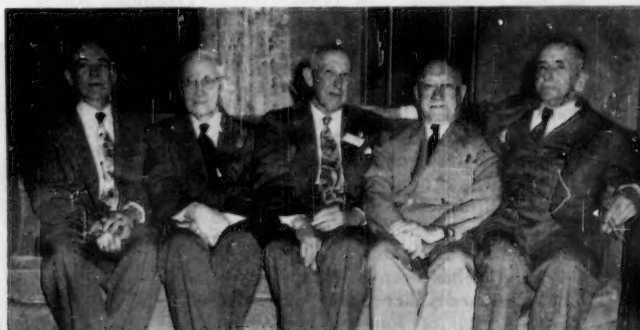
Growing Use of Austenitic Steels in Power Piping Necessitates a Better Knowledge of Fabricating.—Significant Papers on Welding and Joining of Dissimilar Metals for High-Temperature Service: Two groups of researchers from the Babcock & Wilcox Co. have had work under-way for many months and while this will continue, the authors presented the latest results at the meeting, particularly at the strong urging of the Steam Power Panel of the Joint Committee on Effect of Temperature.

Eberle noted that the general trend in the modern steam plants is toward increased pressures and higher temperatures which, in turn, require thicker sections in piping, valves, and structural members where strength is a major consideration. To minimize resulting fabrication difficulties, weight, and costs, materials of greater load-carrying ability at elevated temperatures are constantly being sought. This has led to the use of various austenitic high chromium-nickel alloys which differ from the lower strength ferritic alloys in some important physical properties, such as thermal conductivity, coefficient of expansion, modulus of elasticity, and others.

The joining of such dissimilar ferritic and austenitic alloys presents important design and fabrication problems. Mechanical joints for high temperatures and pressures are large and cumbersome and have inherent difficulties such as stud relaxation and gasket leakage. Welded joints are therefore desirable but offer other problems due to differences in the physical and metallurgical characteristics of the ferritic and austenitic materials.

The difference in the high-temperature load-carrying ability of the two types of materials calls for different thicknesses and special design considerations. The differences in thermal conductivity and in the coefficient of expansion set up stresses at the joint which

(Continued on page 23)



A group of Honorary Members. From l. to r.: Dean Harvey, H. E. Smith, W. C. Hanna, G. H. Clamer, M. E. McDonnell.



B. A. Anderton



R. H. Brown



D. K. Crampton

New A.S.T.M. Officers

THE recent election of officers, as announced at the Annual Meeting, resulted in the election of L. J. Markwardt as President (1950-1951), Truman S. Fuller as Vice-President (1950-1952), and the following as Directors (1950-1953): B. A. Anderton, Robert H. Brown, D. K. Crampton, Harry G. Miller, and J. R. Trimble. Biographical material on these seven men follows.

President

L. J. MARKWARDT, the new President, is Assistant Director, U. S. Forest Products Laboratory, Madison, Wis. Born in Allamakee County, Iowa, Mr. Markwardt graduated from the University of Wisconsin in 1912 with a degree of B.S. in Civil Engineering and later received his C.E. degree. Following service as Assistant City Engineer of Madison, Wis., he joined the faculty of the Engineering College of the University of Wisconsin. At the U. S. Forest Products Laboratory since 1917, where he became Chief of the Division of Timber Mechanics and later Assistant Director, he has had a leading part in important research that has advanced wood as an engineering material. During the recent World War, Mr. Markwardt directed the Laboratory's greatly expanded engineering program carried out for the Armed Services, covering basic engineering research on wood and wood-base materials, studies on improvement and design of shipping containers, and training courses on wood, inspection methods, and packaging. In 1943, Mr. Markwardt served as a member of an aircraft mission to England that was concerned with the interchange of information on design and construction practices in the wood and plastics fields.

Through his intimate background on Timber Mechanics research, he has represented the Forest Products Laboratory and the United States at a number of International Conferences relating to standardization of test methods, procedures, and practices, and has been a member of the Timber Research Committee of the International Union of Forest Research Organizations, and of the Committee on Mechanical Wood Technology of the Food

and Agriculture Organization of the United Nations.

On June 3, 1950, Mr. Markwardt was honored by his alma mater, the University of Wisconsin, when with six other distinguished alumni he received a citation for notable accomplishments in engineering and industrial fields.

In A.S.T.M., with which he has been affiliated since 1920, he has served on the Board of Directors and is completing two years as Vice-President. His most intensive technical work has been in Committee D-7 on Wood, of which he was secretary for a number of years and currently is chairman. In 1943 he delivered the Edgar Marburg Lecture on the subject "Wood as an Engineering Material." This Lecture has received wide distribution. Other A.S.T.M. technical groups in which Mr. Markwardt is active are Committee D-10 on Shipping Containers, C-19 on Structural Sandwich Constructions, C-20 on Acoustical Materials, E-6 on Methods of Testing Building Constructions, and D-20 on Plastics.

A prolific writer, he was co-author during his work at the University of Wisconsin of a pioneering book on Descriptive Geometry, and he has written many reports and bulletins and technical papers.

He is a member and active in the work of many other technical and professional societies including the American Society of Civil Engineers, American Railway Engineering Assn., Forest Products Research Society, Society of American Foresters, and others, including engineering honor fraternities.

Vice-President

TRUMAN S. FULLER, the new Vice-President, is Engineer in Charge of Works



Laboratory, General Electric Co., Schenectady, N. Y.

An up-state New Yorker, Mr. Fuller graduated from Syracuse University in 1911 with a B.S. in Chemistry. His entire industrial experience has been with the General Electric Co., first as chemist, later as metallurgist in the Research Laboratory at Schenectady, then Engineer of Materials, and in his present position as Engineer in Charge of Works Laboratory since July, 1945.

Participating in A.S.T.M. work for many years, he has served two terms on the Board of Directors and has been affiliated with many A.S.T.M. technical groups. A long-time member of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys, he served as Chairman of this important committee from 1926 to 1940. During this period the committee inaugurated many extensive corrosion tests. Other technical work in which he has been and is still active includes steel, cast iron, corrosion of iron and steel, stainless alloys, and radiographic testing. For many years he served on the Research Committee on Fatigue of Metals.

An author of many papers, particularly on metals and alloys, he also is active in the work of other technical organizations and holds membership in the American Society for Metals, American Institute of Mining and Metallurgical Engineers, British Institute of Metals, and the British Iron and Steel Institute.

New Members of Board of Directors

B. A. ANDERTON, Consultant, Research and Development Dept., The Barrett Division, Allied Chemical and Dye Corp., Edgewater, N. J., was born in Pawtucket, R. I., and is a graduate of its public and high schools. Mr. Anderton received his B.S. in Chemistry from Worcester Polytechnic Institute in 1911. He then, as Assistant Chemist, later as Chemist, served with the Bureau of Public Roads, Washington, and in 1918 was Chemist for the Emergency Fleet Corp., U. S. Shipping Board. From 1919 to 1927 he was again Chemist with the Bureau of Public Roads. In 1927, he was appointed Chemist and Supervisor of Research on Bituminous Materials for the Barrett Co., later becoming Consultant in the Research and Development Department of the Barrett Division, Allied Chemical and Dye Corp.

In A.S.T.M., Mr. Anderton has been particularly active in the work of Committee D-4 on Road and Paving Materials

H. G. Miller,

J. R. Trimble



especially those phases involving bituminous materials. He is secretary of the main committee and chairman and a member of numerous subcommittees. He serves on Committees D-7 on Wood and D-18 on Soils for Engineering Purposes and is a member of a subcommittee of Committee E-1 on Methods of Testing. He is affiliated with numerous other associations, including American Institute of Chemists, American Chemical Society, American Wood Preservers' Assn., Forest Products Research Society, Society of Rheology, and the Chemists Club of New York.

ROBERT H. BROWN, Sales Engineer, Parks-Cramer Co., Fitchburg, Mass., obtained his early schooling at Boston Latin School. Mr. Brown later attended Lowell Institute, and after a period of industrial engineering work he attended Massachusetts Institute of Technology, receiving his B.S. degree in Engineering Administration in 1922. His early engineering experience was with the General Electric Co., and later the United Shoe Machinery Corp. For the period 1918-1919 he was in charge of materials testing for the War Department, Airplane Engineering Dept., at McCook Field, Dayton. Since 1922 he has been with his present company, concerned with industrial humidifying and air conditioning problems. His work has involved research and sales engineering.

Mr. Brown's membership in A.S.T.M. dates from 1918, and his activity has been largely concentrated in Committee D-13 on Textile Materials, of which he has been a member for over 25 years. He has served on several subgroups and is Chairman of the Subcommittee on Atmospheric Conditions and Regain. He also serves on the D-13 Advisory Committee and was Vice-Chairman of the main Committee from 1936 to 1942. His other society affiliations include Textile Research Institute and the British Textile Institute, American Society of Heating and Ventilating Engineers, American Society of Refrigerating Engineers, and The American Society of Mechanical Engineers.

D. K. CRAMPTON, Director of Research, Chase Brass and Copper Co., Waterbury, Conn., was born in New Haven, where he attended public schools. Dr. Crampton graduated from Yale with a degree of Ph.B. in Mechanical Engineering. Later he received the degree of M.S. in Metallurgy and his Ph.D. degree was received in 1932. His industrial experience has been concentrated with his present company with which he was first affiliated in July, 1916. Beginning as a laboratory assistant, he received successive promotions and was appointed Director of Research in 1921.



Three busy men at the Annual Meeting. From l. to r.: President J. G. Morrow, Executive Secretary C. L. Warwick, and newly elected President L. J. Markwardt who took office at the close of the Annual Meeting.

His activities in A.S.T.M. have largely been concentrated in the non-ferrous metals field, notably Committees B-5 on Copper and Copper Alloys, B-2 on Non-Ferrous Metals and Alloys, and B-3 on Corrosion of Non-Ferrous Metals and Alloys. In each of these groups he has been a member and officer of numerous subcommittees. He was secretary of Committee B-5 from 1929 to 1937. Other A.S.T.M. work in which he is interested includes metallography and spectrographic analysis.

He has written widely and also has a number of patents on various alloys and on metal treatments. His other society memberships include the American Society of Naval Engineers, American Society for Metals, American Welding Society, British Institute of Metals, American Institute of Mining and Metallurgical Engineers, and American Ordnance Association.

HARRY G. MILLER, Mechanical Engineer, Chicago, Milwaukee, St. Paul and Pacific Railroad Co., Milwaukee, Wis., was born in Creston, Iowa. Mr. Miller received his education in its public schools and graduated from the University of Iowa in 1912 with a B.S. degree in Mechanical Engineering. His long railroad career started with the Burlington Lines, but was interrupted by service in the Army from 1917 to 1919 as a 1st Lieutenant, Field Artillery. Since that time employed by his present company, he has been in successive positions including Chief Inspector, Engineer of Tests, Assistant Mechanical Engineer and, since 1943, Mechanical Engineer.

While his work in A.S.T.M. has largely been concentrated in Committee A-1 on Steel where he heads its important Subcommittee XI on Plates for Boilers and Pressure Vessels, and service on the Advisory Committee as well as other techni-

cal subcommittees, he is also a member of the Chicago District Council.

Mr. Miller has been active in the work of the American Association of Railroads, particularly in its Committee on Specifications for Materials (he was Chairman of this Committee in 1948-1949). His civic activities include a long period of service on the Board of Education, City of West Allis. He is a member of The American Society of Mechanical Engineers and several honor fraternities.

J. R. TRIMBLE, Assistant Manager, Department of Metallurgy, Inspection and Research, Tennessee Coal, Iron and Railroad Co., Birmingham, Ala., graduated from Penn State College in 1924 with the degree of B.S. in Metallurgy. Mr. Trimble was employed in succession in the Open Hearth Dept. of the Homestead Steel Works and Santa Fe Railroad (Metallurgist in Test Dept.) before beginning work in 1933 at the University of Illinois under Prof. H. F. Moore in a cooperative investigation on the causes of transverse fissures in rails. In 1936, he became connected with his present company as Rail Service Engineer and in 1946 was appointed to his present position.

In A.S.T.M. he has been active in the work of Committee A-1 on Steel, being a member of several of its subcommittees including those concerned with rails and track fastenings, forgings, concrete reinforcement, bar steels, and plates for pressure vessels. He represents his company on several of the technical committees of the American Iron and Steel Institute.

His other society and association affiliations include the American Railway Engineering Association, American Institute of Mining and Metallurgical Engineers, American Society for Metals, American Standards Association, and American Ordnance Association.

Medalists and Award Winners

Charles B. Dudley Medal

THIS award is made for a paper of outstanding merit constituting an original contribution on research and engineering materials. It was established

in 1926 as a means of stimulating research in materials and of recognizing meritorious contributions. It commemorates the name of the first President of the Society. 1950 AWARD TO B. J. LAZAN

For his paper, "Dynamic Creep and

Creep-Rupture Properties of Temperature-Resistant Materials Under Tensile Fatigue Loading," B. J. Lazan received this year's Dudley Medal.

Professor Lazan, Head of the Department of Materials Engineering, Syracuse University, Syracuse, N. Y., was pre-

viously associated with the Sonntag Scientific Corp., as executive vice-president. He was then engaged in the development of testing machines. At present he is also an engineering consultant for several companies.

Professor Lazan was recipient of the Founders Societies' Alfred Noble Prize for 1943—again for a technical paper of exceptional merit.

Richard L. Templin Award

The purpose of the award is to stimulate research in the development of testing methods and apparatus, to encourage the presentation to the Society of papers describing new and useful testing procedures and apparatus, and to recognize meritorious efforts of this kind.

1950 AWARD TO DONALD S. CLARK AND D. S. WOOD

"The Time Delay for the Initiation of Plastic Deformation at Rapidly Applied Constant Stress" is the title of this year's winning paper by D. S. Clark and D. S. Wood, California Institute of Technology, Pasadena, Calif.

A faculty member since 1934, and now Associate Professor of Mechanical Engineering, Dr. Clark holds California Institute of Technology as his alma mater. He received his Ph.D. there and immediately joined the faculty. Active in many technical societies, he was a National Trustee of the American Society of Metals in 1939 and 1940. Professor Clark has written several papers on the dynamic properties of metals and their alloys and a book on engineering materials and processes.

Dr. Wood is now a lecturer in Mechanical Engineering at the Institute and is continuing experimental research on the dynamic properties of metals and their alloys. Dr. Wood also received his Ph.D. from California Institute of Technology last year. In 1944 and 1945 he was employed at the Los Alamos Scientific Laboratories in New Mexico and prior to this was engaged in research on propagation of plastic deformation waves in metals at the Institute under N.D.R.C. Contract.

Sam Tour Award

The purpose of the award is to encourage research on the improvement and evaluation of corrosion testing methods and to stimulate the preparation of technical papers in this field

1950 AWARD TO O. B. ELLIS

A paper, "Effect of Weather on the Initial Corrosion Rate of Sheet Zinc," won the Second Sam Tour Award for O. B. Ellis, Senior Research Engineer, Armco Steel Corp., Middletown, Ohio.

In his present capacity, Mr. Ellis supervises Armco's corrosion research activities. Previously, he served as research engineer and assistant chief chemist in the research division with which he had been associated since 1932. After receiving his B.S. degree in Chemistry and M.S. degree in physics from the University of Louisville, Mr. Ellis had taught in public high schools for five years before joining the Armco Steel Corp.



Top, l. to r. B. J. Lazan; D. S. Clark, and D. S. Wood

O. B. Ellis



50-Year and 40-Year Members

ONE of the interesting events at the Annual Meeting Thursday Luncheon was the recognition of individuals and companies that have been connected with the Society continuously for 50 and 40 years.

Certificates were given to six 50-year members and twenty-five 40-year members.

The number of 50-year certificates awarded since the practice was started last year is 16; the total number of 40-year certificates is 183.

There follows a list of the 50-year and of the 40-year members recognized at the 1950 meeting.

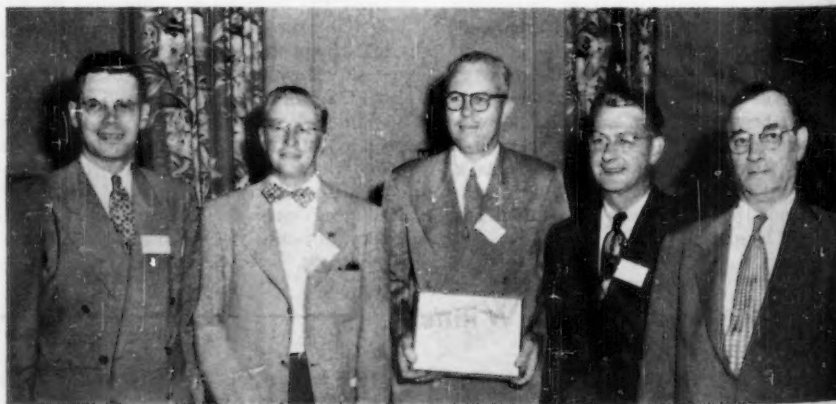
50-YEAR MEMBERS

American Steel and Wire Co.
Colorado Fuel and Iron Corp.
Theodore L. Condron
Robert Job
National Tube Co.

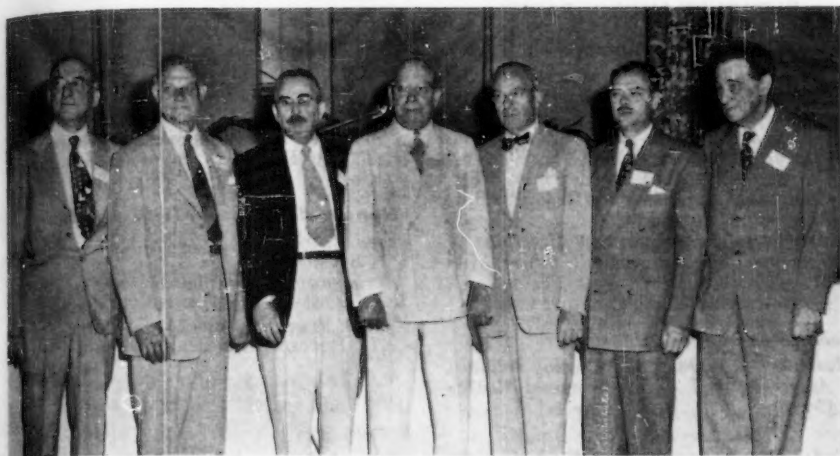
John A. Roebling's Sons Co.

40-YEAR MEMBERS

Lawrence Addicks
American Transit Assn.
Armco Steel Corp.
Charles V. Bacon
P. H. Bates
Bausch & Lomb Optical Co.
L. G. Blackmer
British Ceramic Society
Cementos Mexicanos, S.A.
Flint C. Elder
General Electric Co. (Pittsfield Works)
John Howe Hall
A. E. Horn
William H. Klein
Lehigh Valley Railroad Co.
M. E. McDonnell
J. E. Myers
National Crushed Stone Association, Inc.
City of St. Louis Municipal Testing Laboratory
Stanford University Library
State University of Iowa, Libraries
Studebaker Corp.
Western Union Telegraph Co.
Francis P. Witmer
G. H. Woodroffe



Representatives of 50-Year Members. From l. to r.: A. B. Wilder representing National Tube Co.; Past-President H. H. Morgan who accepted the certificate for his fellow Chicagoan, T. L. Condron; George W. Acock, representing John A. Roebling's Sons Co.; J. H. Shank, representing Colorado Fuel and Iron Corp.; James R. Thompson, representing American Steel and Wire Co.



A group of 40-Year Members and representatives of 40-Year Company Members. From l. to r.: A. T. Goldbeck; G. H. Woodroffe; John Howe Hall; Charles V. Bacon; W. E. Burke, representing Western Union Telegraph Co.; A. W. Baker, representing the American Transit Assn.; J. M. Gauss, representing The Studebaker Corp.

1950 Photographic Exhibit Features Sections on Photomicrography and Electron Micrography

Scope included, Materials, Testing and Research

THE 1950 Photographic Exhibit arranged under the auspices of a special committee of the Philadelphia District attracted considerable attention during the Annual Meeting. There were many prints in the general section and a considerable number of photomicrographs, electron micrographs, and radiographs.

The entries in the general section were judged by the main Photographic Committee, personnel of which is shown below, while those in the sections on photomicrography were evaluated by representatives of Committee E-4 on Metallography which sponsored this section of the exhibit.

The personnel of the Photographic Committee was as follows:

- L. Drew Betz, Chairman, W. H. & L. D. Betz
- Myron Longenberger, Rohm & Haas Co.
- R. R. Moore, U. S. Naval Aircraft Factory
- S. Byron Morehouse, Leeds & Northrup Co.
- John P. Mudd, The Midvale Co.
- E. B. Patterson, Arthur H. Thomas Co.
- Representing Committee E-4 on Metallography:
- D. I. Finch, Leeds & Northrup Co.
- Representing Committee E-7 on Non-Destructive Testing:
- C. B. Jenni, General Steel Castings

As has been noted previously, the Photographic Exhibit provides an excellent opportunity for members to see some of the outstanding work in this field. It stresses the importance and significance of good illustrations and the

fact that they can be obtained, and also gives recognition for outstanding work along photographic and the other lines covered in the exhibit.

A list of the prize winners follows.

It is planned to reproduce many of these prize-winning prints in succeeding issues of the ASTM BULLETIN, some appearing in this issue.

GENERAL SECTION

Group I: Black and White Prints

First: *Final Inspection*, Robert A. Buchanan, United States Steel Corp. Research Laboratories

Second: *Concentricity Check*, J. Jean Vincent, Ethyl Corp.

Third: *Stress Analysis of Piping System Under Bending Strain*, W. M. Pedziwiatr, Crane Co.

Honorable Mention: *Filtering*, Daniel R. Condon, U. S. Testing Co., Inc.

Honorable Mention: *Classified Surface Finish*, William W. C. Wilke, Jr., Crane Co.

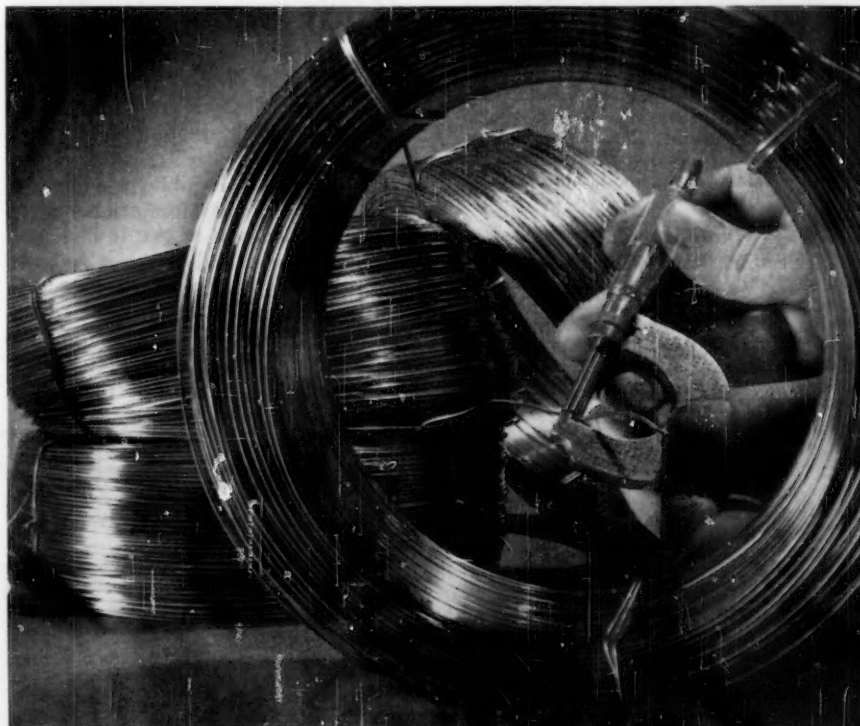
Group II: Color Prints

First: *Food Storage Can*, Howard T. Betz, Armour Research Institute

Second: *Stress Corrosion Furnace*, J. Jean Vincent, Ethyl Corp.

Group III: Color Transparency

First: *Birth of a Hairspring*, Ned S. Aurand, Hamilton Watch Co.



"Final Inspection"

First prize-winning photograph, General Section, in the Seventh A.S.T.M. Photographic Exhibit, by Robert A. Buchanan, United States Steel Research Laboratory.

PHOTOMICROGRAPHS

Group I: Transparencies

- First: *Copper Precipitation at Surface of "Hot Short" High Carbon Steel*, Pat Kenyon, Sheffield Steel Co.
 Second: *Cross Section Partially Acetylated Cotton Yarn*, Ines V. deGruy, Southern Regional Laboratories
 Third: *Graphite Nodule in Nickel Repair Weld on Gray Iron Casting*, A. M. Hall and E. E. Fletcher, Battelle Memorial Institute

Group II: Particles

- First: *Grain Growth in Octachloropropane (100X—Crossed nicols)*, Dr. Walter C. McCrone, Armour Research Foundation
 Second: *Twin Bands in Sublimed Crystals in Uracil (100X)*, Marvin Salzenstein, Armour Research Foundation
 Third: *View Through a Binocular with Moldy Optical Glass Elements (6X)*, Pitman-Dunn Laboratory, Frankford Arsenal
 Honorable Mention: *Fax Film Replica of Manganese Base Phosphate Coating*, Paul C. Cunick, Rock Island Arsenal

Group III: Color

- First: *Cross-Sections of Experimental Galvanized Coating Immediately After Etching*, D. H. Rowland, Carnegie-Illinois Steel Corp.
 Second: *Polishing Scratches Revealed by Air (250X)*, Francis L. Shubert, Battelle Memorial Institute
 Third: *Nitralloy, Cycle Annealed for Machinability*, B. F. Handel, Tube-Turns, Inc.

Group IV: Fibers

- First: *Attachment of Cotton Fibers in Epidermis of Seed Coat (825X)*, Ruth Guiffria and Enno Schoenhardt, Southern Regional Research Laboratory
 Second: *Ultraviolet Light Micrograph of Unstained Microtomed Thyroid Gland of Dog*, E. J. Thomas and Edmund Mayer, American Cyanamid Co.
 Third: *Cotton Fibers Swelled in Cupri-Ethylene Diamine Phase*, John M. Facq, Bates Mfg. Co.
 Honorable Mention: *Stock Failure in Tire Carcass, Adhesion Failure in Tire Carcass*, Harold E. Todd, Gates Rubber Co.

Group V: Metallographs

- First: *Pearlite Taken on a Light Microscope (9500X)*, R. T. Knaggs, General Electric Co.
 Second: *Graphite "Squid" in Gray Cast Iron*, Pitman-Dunn Laboratory, Frankford Arsenal
 Third: *Copper Strip Thermally Etched in Lead Vapor*, Estelle Kontaleon, General Electric Co.
 Honorable Mention:
 First: *Resolution*, F. G. Foster, Bell Telephone Laboratories
 Second: *Slip Lines in 2.88 Si, 1.12 Mn Silicon Bronze Material*, Cornelius A. Johnson, Illinois Institute of Technology
 Third: *High Manganese Cast Iron*, Nicholas Iannone, Bausch & Lomb Optical Co.

Group VI: Photomicrographs

- First: *Gold Filled Watch Case with Soldered Joint*, J. Presto, Hamilton Watch Co.
 Second: *Etched Surface of Charcoal Grade Tin Plate*, D. H. Rowland, Carnegie-Illinois Steel Co.

ELECTRON MICROGRAPHS

First Prize (blue ribbons)

- Bainite—Isothermally Transformed at 500 F.*, William L. Grube, General Motors Corp.
Electron Micrograph of Serpentine from Espanola, Sudbury, Ontario, F. G. Rowe, D. W. Davis, and Prof. P. F. Kerr, Columbia University, and T. G. Rochow, American Cyanamid Co.
Macromolecules of Two Size Fractions of Commercial Polyacrylonitrile Fibers, Miss M. L. Miller, M. C. Botty, and T. G. Rochow, American Cyanamid Co.

Second Prize (red ribbons)

- Martensite—As Quenched Showing Retained Austenite*, W. L. Grube, General Motors Corp.

Ninth Apparatus Exhibit Features Many New Instruments

WHILE there was much of interest for almost every member and visitor who attended the Ninth Exhibit of Testing Apparatus and Related Equipment held in Atlantic City during the week of the Annual Meeting, probably the one over-all feature which may have impressed all those present was the relatively large number of new instruments and new laboratory equipment which the leading companies in the exhibit had on display, much of it for the first time.

The equipment on display gave an excellent conception of what the apparatus and instrument industry has been doing in developing new items and improving older equipment.

Of course, much of the equipment featured is used in carrying out A.S.T.M. tests and other standard procedures, but a good deal of it was of interest to research investigators who might not be concerned with standard techniques in their work.

The A.S.T.M. Exhibit provides an excellent opportunity for members and committee members to get, in one concentrated period and location, a good conception of developments in the apparatus and laboratory supply field, and it also affords exhibitors not only an opportunity to show their material to an influential audience but to discuss with this group needs and trends.

The May BULLETIN gave condensed descriptions of the various displays, and details were also noted in the final program at the meeting. A list of the companies in the field who were in the Exhibit follows:

American Instrument Co.
 H. Reeve Angel & Co., Inc.
 Atlas Electric Devices Co.
 Baird Associates, Inc.
 The Baldwin Locomotive Works
 Bethlehem Apparatus Co.
 Brabender Corporation
 Brookfield Engineering Labs., Inc.
 The Brush Development Co.
 Buehler Ltd.

Resinography of Interior of Natural Rubber Tire Tread Stock, F. G. Rowe and T. G. Rochow, American Cyanamid Co.

A Photographic Study of the Diatom: Pleurasisigma Angulatum, A. F. Kirkpatrick, E. J. Thomas, F. Rowe, and T. G. Rochow, American Cyanamid Co.

Honorable Mention (white ribbons):

Fine Pearlite and Bainite, D. M. Teague, Chrysler Corp.
Resinography of a Commercial Nylon Film, Prof. H. Mark, Institute of High Polymer Research, and M. C. Botty and T. G. Rochow, American Cyanamid Co.

Burrell Corporation
 The Central Scientific Co.
 Consolidated Engineering Corporation
 Corning Glass Works
 Custom Scientific Instruments, Inc.
 J. W. Dice Co.
 Eastman Kodak Co.
 Henry A. Gardner Laboratory, Inc.
 General Radio Co.
 Hanovia Chemical & Manufacturing Co.
 Instron Engineering Corp.
 Jarrell-Ash Co. and National Spectrographic Labs., Inc.
 Leeds & Northrup Co.
 Magnaflux Corp.
 National Forge & Ordnance Co.
 Tinius Olsen Testing Machine Co.
 Radium Chemical Co., Inc.
 Riehle Testing Machines Division, American Machine and Metals, Inc. Rubicon Co.
 Scott Testers, Inc.
 Sperry Products, Inc.
 Steel City Testing Machines, Inc.
 The Superior Electric Co.
 Tagliabue Instruments Division, Weston Electrical Instrument Corp.
 Arthur H. Thomas Co.
 Thwing-Albert Instrument Co.
 Will Corporation
 Wilson Mechanical Instrument Co.
 The Young Testing Machine Co.

News About the American Railway Engineering Association

NEAL D. HOWARD, formerly western editor and engineering editor of *Railway Age*, has succeeded W. S. Lacher as secretary of the American Railway Engineering Association. Mr. Lacher retired after many years of outstanding service, and in March at the A.R.E.A. meeting he was presented a framed resolution of appreciation by the A.R.E.A. Board.

A recent issue of *A.R.E.A. News* also carried the news of the resignation as president of A.R.E.A. of George L. Sitton, who was forced on the advice of his doctors to relinquish the presidency to which he had just been elected. A.R.E.A. senior Vice-President H. S. Loeffler thus becomes the senior officer of this association. The A.R.E.A. Headquarters are at 59 E. Van Buren St., Chicago, Ill.

Six Honorary Memberships Awarded

Messrs. P. H. Bates, W. C. Hanna, Dean Harvey,
Prévost Hubbard, Robert Job, and H. S. Rawdon Honored

IN RECOGNITION of their meritorious services to the Society over long periods of time and their eminence in the field of work in which the Society is engaged, six long-time A.S.T.M. members were awarded Honorary Memberships during the 1950 Annual Meeting. All of these men—P. H. Bates, Wilson Hanna, Dean Harvey, Prévost Hubbard, Robert Job, and Henry Rawdon—are outstanding in their respective fields and it was considered most fitting that they should receive the highest honor the Society bestows.

President J. G. Morrow gave the recipients their membership certificates following brief citations given by Executive Secretary Warwick. Biographical information on each of the six new Honorary Members follows.

Phaon Hilborn Bates

PHAON HILBORN BATES, retired, formerly Chief, Clay and Silicate Products Division, National Bureau of Standards, Washington, D. C., was born in 1879 in Sipesville, Pa., and after graduating from the University of Pennsylvania in 1902 became Assistant Chemist, Pennsylvania Railroad, serving in that capacity until 1906. While at Altoona, Pa., he was associated with A.S.T.M.'s first President, Charles B. Dudley, then Chief Chemist of the Pennsylvania R.R. Later he was Chemist, Technologic Branch, U. S. Geological Survey, St. Louis, and from 1910 to 1919 was in charge of the Pittsburgh Branch of the National Bureau of Standards. During the next two years he was Chief, Structural Miscellaneous Materials Division at the Bureau, and also Acting Chief of the Ceramic Division. He became Chief of the Clay and Silicate Products Division in 1921, retiring from that post in 1945. His present residence is in St. Petersburg, Fla.

A member of A.S.T.M. since 1910, Mr. Bates was active through the years in numerous technical committees. He served on former Committee C-6 on Drain Tile for 20 years, and on the former Joint Committee on Concrete and Reinforcing Concrete for 12 years. He was an active participant in the work of Committee C-15 on Manufactured Masonry Units for 8 years, and in the work of Committee D-4 on Road and Paving Materials for 18 years. His most intensive technical work, however, was in Committee C-1 on Cement with which he has been affiliated since 1914, and where he served as Secretary (1916-1922), and Chairman (1926-1945), rendering important service also as member and chairman of many of its subgroups. He was made an honorary member of Committee C-1 in 1945.

Mr. Bates was a member of the A.S.T.M. Board of Directors (1937-1939), Vice-President of the Society (1942-1944), and President (1944-1945). He was a member of the Special Study Committee which made an exhaustive study of A.S.T.M. operations, and was the 1940 Edgar Marburg Lecturer on the subject "Portland Cement—Theories (Proven and Otherwise) and Specifications." Many of his technical papers are included in the ASTM BULLETIN and Proceedings. He has contributed many papers before various societies giving results of research in cements, concrete, and ceramics.

Among other technical and scientific associations with which he is affiliated are the American Academy for the Advancement of Science, American Ceramic Society, American Concrete Institute (of which he is a Past-President), and the American Chemical Society. He is a member of the Cosmos Club.

Wilson C. Hanna

WILSON C. HANNA, Chief Chemist and Chemical Engineer, California Portland Cement Co., Colton, Calif., was born in Leadville, Colo., in 1883, and in 1903 be-

gan his industrial work in the laboratory of the California Portland Cement Co., the pioneer cement-producing plant of the western United States. He attended Pomona College and took special work under Prof. R. C. Carpenter of Cornell University. He was the ninth A.S.T.M. member from California, joining in 1905 at the invitation of Professor Edgar Marburg, then Secretary-Treasurer.

Since 1912, when he attended his first Annual A.S.T.M. Meeting, the regularity of Mr. Hanna's attendance at annual and committee meetings, and his untiring attention to all work assigned him, have been most noteworthy. He has been particularly active in the field of cementitious materials, being a member of Committee C-1 on Cement since 1927, of Committee C-7 on Lime since 1929, of Committee C-9 on Concrete and Concrete Aggregates since 1933, and of Committee C-12 on Mortars for Unit Masonry since 1932—rendering outstanding service on many of the various subgroups and sections as member or chairman. His pioneering and continuing work on chemical analysis of cement is the basis of current standard methods. He was 1948 recipient of the Sanford E. Thompson Award for his paper "Unfavorable Chemical Reactions of Aggregates in Concrete and a Suggested Corrective."

He was a member of the Board of Directors (1944-1947) serving as Chairman of its Subcommittee on Membership (1945-1946). Not only was the influence of his membership efforts felt during this period, but throughout his 45 years of membership he continuously has been instrumental in furthering the Society's growth and prestige on the Pacific Coast. Since 1939 he has been an active member of the Southern California District Council, serving successively as Chairman and Vice-Chairman for 2-year periods.

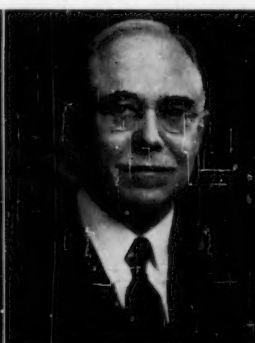
Mr. Hanna is a member of a number of scientific organizations, including American Institute of Chemical Engineers, American Chemical Society, American Con-



P. H. Bates



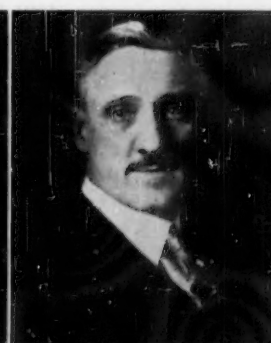
W. C. Hanna



Dean Harvey



Prévost Hubbard



H. S. Rawdon

A photograph of Robert Job was not available for this BULLETIN.

crete Institute, Committee on Technical Problems of the Portland Cement Association, and a number of ornithological societies (his hobby from early boyhood has been the study of ornithology and the collection of birds' eggs—his collection is one of the most complete in the United States). He also has been active through the years in many civic and welfare groups in his community. Currently he is Vice-Chairman, Boy Scouts Council; Acting Chairman of the Colton Library Committee, and was Chairman of his Community's 1950 Industrial Fair.

Dean Harvey

DEAN HARVEY, born in Chicago in 1879, and a graduate of the Armour Institute of Technology, was associated with the Underwriters' Laboratories as Electrical Engineer (1900-1904), and from 1904 to 1946 was affiliated with the Westinghouse Electric & Manufacturing Co., Pittsburgh, as Electrical and Materials Engineer. During World War II he devoted several days weekly to War Production Board work in Washington as a consultant in the Conservation Division concerned chiefly with electrical and mechanical work. Since his retirement from Westinghouse in 1946 he has been engaged in private practice as a consultant on materials.

Joining the Society in 1913, Mr. Harvey has been extremely active in both technical and administrative phases of A.S.T.M. work. His continuous and intensive activity over three decades in Committees B-4, D-9, and D-13 has been most outstanding. He was Chairman of B-4 on Electrical Heating, Resistance, and Related Alloys (1925-1946), and was elected honorary chairman and an honorary member of Committee B-4 in 1946. Since 1921 he has been a member of Committee D-9 on Electrical Insulating Materials, acting successively as representative of Westinghouse and the National Electrical Manufacturers Association and on his personal membership—serving as Vice-Chairman (1926-1944), and on at least fifteen of the subcommittees through the years. He has been affiliated with Committee D-13 on Textile Materials since 1923, serving on more than twenty subgroups for varying periods, and being elected to honorary membership in this committee in 1946.

He has also served relatively long periods on Committees A-1 on Steel, E-5 on Fire Tests of Materials and Construction, and E-6 on Methods of Testing Building Constructions; since 1921 he has been a member of Committee E-8 on Nomenclature and Definitions. He is presently a member of A.S.A. Sectional Committee C 59 on Electrical Insulating Materials.

Mr. Harvey also served as a member of the Society's Committee on Papers, was a member of the Board of Directors (1938-1940), Vice-President of the Society (1941-1943), and President (1943-1944). He has been a member of the Pittsburgh District Council since 1931, serving as Chairman (1934-1938).

His technical contributions have been published in the A.S.T.M. *Proceedings* and elsewhere including the *Electric Journal*. In 1943 he was honored by receiving the

Westinghouse Award of Merit for distinguished service in developing materials and process specifications, for notable work in connection with insulating oils, and for his contributions to the war effort in the War Production Board Conservation Division.

In addition to A.S.T.M. affiliation, Mr. Harvey holds membership in the American Institute of Electrical Engineers.

Prévost Hubbard

PRÉVOST HUBBARD, actively connected with highway work for 45 years, and an authority in the field of asphalt testing, was born in 1881 in Washington, D. C. Following graduation from George Washington University, he was with the Office of Public Roads from 1905 to 1911, first as Assistant and later as Chief Chemist. From 1911 to 1915 he was Consulting Chemical Engineer in Charge of the Division of Roads and Pavements, Institute of Industrial Research, and for this period also was Lecturer on Chemistry of Bituminous Materials, Graduate Department, Columbia University. For four years, beginning 1915, he was Chief, Division of Road Material Tests and Research, U. S. Bureau of Public Roads. During World War I he served as adviser to the U. S. Highway Council and the U. S. Fuel Administration. From 1919 to 1948, when he retired, he was affiliated as Chemical Engineer with The Asphalt Institute, New York City.

Joining A.S.T.M. in 1908, Mr. Hubbard served as Secretary of Committee D-4 on Road and Paving Materials (1908-1946), and as Secretary of Committee D-8 on Bituminous Waterproofing and Roofing Materials (1922-1946), both of which groups have elected him to honorary committee membership.

Mr. Hubbard also served on the Administrative Committee on Papers and Publications (1919-1922), Committee E-1 on Methods of Testing for 21 years (1924-1945), and on Committee E-8 on Nomenclature and Definitions for 25 years (1920-1945).

Mr. Hubbard was a member of the Society's Board of Directors (1920-1922), and served on the New York District Council (1931-1935). He is credited with 9 papers and 19 discussions presented before the Society.

He is an affiliate of the American Society of Civil Engineers, a past-fellow of the American Society for the Advancement of Science, a member of the Permanent International Association of Road Congresses and also the American Society of Municipal Engineers, and Past-President and Chairman of the Research Committee of the Association of Asphalt Paving Technologists. He is the author of numerous government bulletins, over a hundred technical articles on highway materials and their use, and of several books.

Robert Job

ROBERT JOB, born 1866 in Boston, Mass., graduate of Harvard (1890), and a leader in the field of industrial chemistry, was employed as Assistant Chemist and Chemist for the Philadelphia and

Reading Railway (1892-1906); from 1906 to 1910 was a member of the firm of Booth, Garrett and Blair, Chemists, Philadelphia, and since 1910 has been Vice-President of Milton Hersey Co., Ltd., Testing Laboratories, Montreal, Canada, retiring from active duties in 1947. He also served through the years as chemist for various railroads, including Lehigh Valley, Grand Trunk, North, Canadian National, and Canadian Pacific.

Mr. Job this year rounds out a half-century of A.S.T.M. affiliation. Joining 1900, he rendered special service to the Society through his experience and knowledge bearing on steel rails, iron castings, bearing metals, oils, paints and varnishes, patent chemistry, causes of failure of materials, metallurgy, alloys, etc. He has been a member of Committee A-1 on Steel continuously since 1913. He has been a member of Committee A-3 on Cast Iron for 40 years, rendering service as chairman and member of several subgroups, and is at present serving on the Subcommittees on General Castings and Methods of Testing. He was a member of Committee A-5 on Corrosion of Iron and Steel (1910-1948); and of Committee A-7 on Malleable-Iron Castings (1918-1948). He also served on Committee D-1 on Paint from 1910 to 1948, being active on a number of subcommittees; and was a member of Committee E-3 on Chemical Analysis of Metals from 1935 to 1948.

Mr. Job presented at least 12 papers before meetings of the Society, and contributed to 42 discussions. He was a member of the Board of Directors (1914-1916).

In addition to A.S.T.M. affiliation, he is a member of the American Chemical Society, the Society of the Chemical Industry, American Institute of Mining and Metallurgical Engineers, American Society for Metals, The Franklin Institute, and the Canadian Institute of Chemistry.

Henry S. Rawdon

HENRY S. RAWDON, born in Derby, England, in 1882, graduated from Michigan Normal College, and received the degree of B.Ch.E. from the University of Michigan in 1912. He was engaged in educational work in the High Schools of Michigan (1903-1909), and from 1912 until his retirement in 1946 was associated with the National Bureau of Standards, Washington, D. C., first as Physicist and later as Principal Metallurgist and Chief of the Division of Metallurgy.

Joining the A.S.T.M. in 1917, he has been active in the work of many of the technical committees over long periods. He was a member of Committee A-5 on Corrosion of Iron and Steel from 1925 to 1947, holding membership on four of the subgroups through most of the period, and serving as Chairman of Subcommittee VII on Methods of Testing for 2 years. He was a member of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys from 1929 to 1942, including membership on two of its subgroups for many years.

In the non-ferrous field, he served on

Committee B-2 on Non-Ferrous Metals and Alloys, and five of its subcommittees for 7 years; on Committee B-6 and two of its subgroups for the same period, and on B-7 on Light Metals and Alloys for 2 years. His most intensive work in the "B" group, however, was in B-3 on Corrosion of Non-Ferrous Metals and Alloys, where he has rendered outstanding service since 1922, acting as Vice-Chairman (1925-1944), and Chairman (1944-1948), as well as Chairman of two of the subgroups for 4-year periods, and serving on several of the subcommittees for long periods.

He served on Committee E-4 on Metallography for 17 years, and was a member of two of its subgroups and chairman of one for most of that time. He also served on the following: Research Committee on Fatigue of Metals for 15 years, Coordinating Committee on Corrosion for 12 years, Joint Committee on Phosphorus and Sulfur for 3 years, A.S.A. Sectional Committee G8 on Specifications for Zinc Coating of Iron and Steel for 6 years, and on A.S.A. Sectional Committee H1 on Zinc and Zinc Ores for 8 years.

An authority in the field of metals microscopy, corrosion and corrosion prevention, coated metal products, etc., Mr. Rawdon has contributed much to A.S.T.M. research and standardization in this sphere. He has presented 7 papers and participated in 32 discussions at A.S.T.M. meetings.

In addition to A.S.T.M. affiliation he is a member of the American Institute of Mining and Metallurgical Engineers, the American Society for Metals, and the Washington Academy of Science.



A. W. Dow



P. H. Walker



T. G. Stitt



H. P. Ferguson

Several Awards of Merit Conferred

Nine Members Honored for Outstanding Service

At the Luncheon Session of the 1950 Annual Meeting in Atlantic City on Thursday, June 29, the Board of Directors conferred the first of the Awards of Merit, thus recognizing outstanding services in various fields of work of the Society. The men thus honored were as follows:

Alfred P. S. Bellis
Harold F. Dodge
Allan W. Dow
Howard P. Ferguson
Daniel W. Kessler
Thomas G. Stitt
T. Smith Taylor
Percy H. Walker
LeRoy L. Wyman

Merit, presented the awards, and brief citations were read as each received his certificate. Two of the men were unable to attend—T. G. Stitt, who missed his first Annual Meeting in many years because of an important conflicting technical meeting, and Percy H. Walker, who was ill.

The Award of Merit was established by the Board of Directors in 1949 as a means of recognizing individuals who have rendered distinguished service to the Society, particularly as their activities have involved the various technical committees. Each technical committee under the rules governing the Award may suggest one candidate, and these suggestions together with others are

then reviewed by an Award of Merit Committee which makes nominations to the Board of Directors. There is a limitation on the number of Awards which may be granted each year.

There are various types of service which can be considered in proposing candidates.

The form of the Award consists of an appropriate certificate duly authenticated with the Society seal.

CITATIONS

The following citations will give some idea of the services which are recognized by these first 1950 Awards. Each of the men honored has rendered service along many lines of activity but his work was particularly intensive in the field noted in the citation.



T. S. Taylor



D. W. Kessler



A. P. S. Bellis



L. L. Wyman



H. F. Dodge

Alfred P. S. Bellis

To Alfred P. S. Bellis, retired, formerly Chief Electrical Engineer, John A. Roebeling's Sons Co., Trenton, N. J., for pioneering and long-time efforts in Committee B-1 on Wires for Electrical Conductors. His service in the committee for upwards of 40 years and his experience, knowledge, and sound judgment have been invaluable to the committee, and have greatly aided in the development of one of the most widely used groups of specifications in the Society.

Harold F. Dodge

To Harold F. Dodge, Quality Results Engineer, Bell Telephone Laboratories, Inc., New York City, for his pioneering efforts on the interpretation and presentation of data, especially in the preparation of the ASTM Manual on Presentation of Data, which has been a means of introducing to and stimulating a better understanding of this subject by the committees of the Society and by engineers, technicians, and research men throughout the country. His fine qualities of leadership are being continued in his present chairmanship of Committee E-11 on Quality Control of Materials.

Allan Wade Dow

To Allan Wade Dow, Consulting Engineer, New York City, a Fifty-Year Member of the Society who has rendered distinctive service to the Society, especially in the fields of road and paving materials and bituminous waterproofing and roofing materials. His wide professional experience and his sincere devotion to the work and ideals of the Society are reflected in many of the standards developed in Committees D-4 on Road and Paving Materials and D-8 on Bituminous Waterproofing and Roofing Materials.

Howard P. Ferguson

To Howard P. Ferguson, Chief, Refinery Control Division, Manufacturing Department, The Standard Oil Company (Ohio), Cleveland, for notable accomplishments in promoting the work of the Society, especially in Committee D-2 on Petroleum Products and Lubricants; for his contributions to the district activities of the Society in Cleveland; and for his effective work in spreading throughout the petroleum and related industries a better realization and understanding of the work of A.S.T.M. and its significance to producers and consumers of petroleum products.

Daniel W. Kessler

To Daniel W. Kessler, Chief of the Building Stone Section, National Bureau of Standards, Washington, D. C., for long and distinguished service to the Society in the field of natural building stones, including the development of the A.S.T.M. Standard Methods of Test sponsored by Committee C-18 on Natural Building Stones. His painstaking researches over the years have formed the basis of these standards, and he has given to the committee inspiring leadership.

Thomas G. Stitt

To Thomas G. Stitt, Chief Inspecting Engineer, Pittsburgh Steel Company, Allentown, Pa., for his distinguished service in Committee A-1 on Steel, of which he is a Vice-Chairman, and notably as Chairman of the Subcommittee on Steel Tubing and Pipe, which he has headed since 1934. The tremendous increase in the use of steel tubular products in the power industry, oil fields, and elsewhere has given unusual significance to the group of 30 A.S.T.M. specifications for these products, in the writing of which Mr. Stitt has made an outstanding contribution to the Society's work.

LeRoy L. Wyman

To LeRoy L. Wyman, Research Metallurgist, Knolls Atomic Power Laboratory, General Electric Co., Schenectady, N. Y., for his devoted interest in the activities of the Society, more especially in Committee E-4 on Metallography, of which he has been chairman since 1938, where his leadership and untiring efforts have led to important contributions by the committee and have kept the committee abreast of technical advancements in its fields. He has also served the Society notably in its work on X-Ray Diffraction Methods, and more recently in the field of Simulated Service Testing in his capacity as chairman of the Administrative Committee on that subject.

T. Smith Taylor

To T. Smith Taylor, of the United States Testing Co., Inc., Hoboken, N. J.—A.S.T.M. Edgar Marburg Lecturer in 1937 on Plastics, then a pioneer development, and an officer of Committee D-9 on Electrical Insulating Materials for many years—for his outstanding and constructive contributions to the work of the Society in the fields of electrical insulating materials, plastics, and textiles, and in the development of general methods of testing in Committee E-1.

Percy H. Walker

To Percy H. Walker, retired, formerly associated with the National Bureau of Standards, Washington, D. C., for many years as Chief of the Chemistry Division, for his long-time and aggressive activities in behalf of the Society, and in Committee D-1 on Paint, Varnish, Lacquer and Related Products, of which he was chairman for many years, and for his forceful stimulation of research underlying many of the standards sponsored by this committee.

News of Industrial Research Institute

MEMBERS will possibly be interested in some notes on a meeting of the Industrial Research Institute, Inc., which was held April 26-28 at Rye, N. Y.

Officers elected were as follows:

Dr. C. F. Rasweiler, Vice-President for Research and Development, Johns-Manville Corporation, New York—elected President.

Dr. Harry N. Stephens, Director of Research, Minnesota Mining and Manufacturing Company, St. Paul—elected Vice-President.

C. G. Worthington Continues as full-time Secretary-Treasurer.

Dr. Allen Abrams, Vice-President, Marathon Corp., Rothschild, Wis.—elected to Board of Directors.

James A. Stewart, Vice-President in Charge of Research and Development, American Can Co., New York—elected to Board of Directors.

Atomic energy and its possible non-military uses, as well as relationships between the U. S. Atomic Energy Commis-

sion and industrial research laboratories, were discussed. Sumner T. Pike, Acting Chairman of the Commission and Carroll L. Wilson, General Manager, headed the list of speakers from industry and the Commission.

The development of people for management positions in industry and particularly in industrial research was discussed by W. B. Given, Jr., President, American Brake Shoe Co., and H. G. Vesper, President, California Research Corp. A survey on what Industrial Research Institute companies are doing toward developing methods for calculating the financial returns from research was reported by Dr. Abrams of Marathon Corp.

Testing at the National Bureau of Standards

CIRCULAR 483 issued by the National Bureau of Standards explains the policy, provides general information, and gives the fee schedule of testing at the Bureau. This document can be procured

from the Government Printing Office at 25 cents. After a short statement of the functions of the Bureau, there is a statement on the testing and calibration policy in effect. Tests which may be carried out involve comparison of laboratory standards, tests of various devices and materials which are critical in laboratory or industrial operations where such facilities are not available elsewhere, and referee tests or investigation where private laboratories agree on the method or result, but in the latter case the problem has to be of national interest with costs borne by the groups at issue, and other conditions must be met. It is stated that the Bureau does not compete with qualified commercial testing laboratories, nor does it carry on general testing for the public. The facilities and information are given under the following general headings: Electricity, Metrology, Heat and Power, Atomic and Molecular Physics, Chemistry, Mechanics, Radio Propagation, Optics. The booklet comprises 100 pages.

List of New and Revised Tentatives with Serial Designations

THE Society accepted at the Annual Meeting 63 new tentatives and revisions in 98 former tentative specifications and methods of test. Of the revised tentative specifications and methods, 30 have been extensively revised and the titles of these are given below (marked with an asterisk) with the list of those issued by the Society for the first time. Technical committees responsible for the various items are indicated.

Steel

(Committee A-1)

Specifications:

- Steel Sheet Piling (A 328-50 T).
- Heat-Treated Steel Tires (A 329-50 T).

Methods and Definitions:

- Mechanical Testing of Steel Bars (A 330-50 T).

Cast Iron

(Committee A-3)

Methods:

- Impact Testing of Cast Iron (A 327-50 T).

Corrosion of Iron and Steel

(Committee A-5)

Specifications:

- *Zinc-Coated (Galvanized) Iron or Steel Sheets, Coils and Cut Lengths (A 93-50 T).
- *Long Terne Iron or Steel Sheets, Coils and Cut Lengths (A 308-50 T).

Electrical Heating, Resistance, and Related Alloys

(Committee B-4)

Method of Test:

- Relative Thermionic Emissive Properties of Materials Used in Electron Tubes (B 246-50 T).

Light Metals and Alloys, Cast and Wrought

(Committee B-7)

Specifications:

- Aluminum-Alloy Die Forgings (B 247-50 T).

Cement

(Committee C-1)

Method of Test:

- Bleeding of Cement Pastes and Mortars (C 241-50 T).

Ceramic Whitewares

(Committee C-21)

Definitions:

- Terms Relating to Ceramic Whitewares (C 242-50 T).

Paints, Varnish, Lacquer, and Related Products

(Committee D-1)

Specifications:

- *Pure Para Red Toner (D 475-50 T).

Methods of Test:

- Heptane Number of Hydrocarbon Solvents (D 1132-50 T).
- Kauri-Butanol Value of Hydrocarbon Solvents (D 1133-50 T).
- Nitrocellulose Diluting Power of Hydrocarbon Solvents (D 1134-50 T).

Methods:

- *Chemical Analysis of Blue Pigments (D 1135-50 T).
- *Chemical Analysis of Zinc Dust (Metallic Zinc Powder) (D 521-50 T).
- *Testing Varnishes (D 154-50 T).
- *Preparation of Steel Panels for Testing Paint, Varnish, Lacquer, and Related Products (D 609-46 T).
- *Chemical Analysis of Yellow, Orange, and Green Pigments Containing Lead Chromate, and Chromium Oxide Green (D 126-50 T).

Petroleum Products and Lubricants

(Committee D-2)

Specifications:

- *Diesel Fuel Oils (D 975-50 T).

Methods of Test:

- Apparent Viscosity of Lubricating Grease (D 1092-50 T).
- Boiling Point Range of Polymerization-Grade Butadiene (D 1088-50 T).
- Carbonyl Content of Butadiene (D 1089-50 T).
- Phosphorus in Lubricating Oils, Lubricating Oil Additives, and Their Concentrates (D 1091-50 T).
- Analysis of 60 Per Cent Isooctane 40 Per Cent Normal Heptane Blends by Infrared Spectrophotometry (D 1095-50 T).
- 1,3-Butadiene in C₄ Hydrocarbon Mixtures by Ultraviolet Spectrophotometry (D 1096-50 T).
- Acidity of Residue from Distillation of Gasoline and of Petroleum Solvents (D 1093-50 T).
- Acidity of Residue from Distillation of Gasoline and of Petroleum Solvents (D 1093-50 T).
- Water Tolerance of Aircraft Fuels (D 1094-50 T).
- *Rust-Preventing Characteristics of Steam-Turbine Oil in the Presence of Water (D 665-50 T).

Factors and Tables:

- Volume Correction and Specific Gravity Conversion of Liquefied Petroleum Gases (D 1090-50 T).

Road and Paving Materials

(Committee D-4)

Method of Test:

- Bitumen Content of Paving Mixtures (D 1097-50 T).

Paper and Paper Products

(Committee D-6)

Specifications:

- Filter Paper for Use in Chemical Analysis (D 1100-50 T).

Methods of Tests:

- Static Bending Test for Corrugated Paperboard (D 1098-50 T).
- Water-Soluble Sulfates in Paper and Paperboard (D 1099-50 T).
- Organic Nitrogen in Paper and Paperboard (D 982-50 T).

Wood

(Committee D-7)

Methods of Testing:

- Integrity of Glue Joints in Laminated Wood Products for Exterior Service (D 1101-50 T).
- *Small Clear Specimens of Timber (D 143-50 T).

Methods of Test:

- Ash in Wood (D 1102-50 T).
- Water Solubility of Wood (D 1110-50 T).
- Ether-Solubility of Wood (D 1108-50 T).
- Alcohol-Benzene Solubility of Wood (D 1107-50 T).
- One Per Cent Caustic Soda Solubility of Wood (D 1109-50 T).
- Holocellulose in Wood (D 1104-50 T).
- Lignin in Wood (D 1106-50 T).
- Alphacellulose in Cellulose Materials (D 1103-50 T).

Method:

- Preparation of Extractive-free Wood (D 1105-50 T).

Bituminous Waterproofing and Roofing Materials

(Committee D-8)

Definitions:

- Terms Relating to Bituminous Waterproofing and Roofing Materials (D 1079-50 T).

Electrical Insulating Materials

(Committee D-9)

Methods:

- *Testing Electrical Insulating Oils (D 117-50 T).
- *Testing Glass-Bonded Mica for Electrical Insulation (D 1039-50 T).
- *Sampling and Testing Untreated Paper Used in Electrical Insulation (D 202-50 T).

Rubber and Rubber-Like Materials

(Committee D-11)

Methods:

- *Chemical Analysis of Rubber Products (D 297-45 T).

Soaps and Other Detergents

(Committee D-12)

Specifications:

- Solid Soap for Low-Temperature Wash-

ing (Low and Medium Titer) (D 1112-50 T).
Chip or Granular Soap for Low-Temperature Washing (Low and Medium Titer) (D 1111-50 T).

Textiles

(Committee D-13)

Specifications:

Mechanical Sheet Felt (D 1114-50 T).

Specifications and Methods of Test:

*Fineness of Wool Tops (D 472-50 T).

Methods of Test:

Resistance of Pile Floor Coverings to Insect Pest Damage (D 1116-50 T).

Vegetable Matter in Scoured Wool (D 1113-50 T).

Snag Resistance of Hosiery (D 1115-50 T).

Magnetic Rating of Asbestos Used for Electrical Purposes (D 1118-50 T).

*Fastness of Colored Textiles to Light (D 506-50 T).

*Resistance of Textile Fabrics to Water (D 583-50 T).

*Resistance of Textile Materials to Microorganisms (D 684-50 T).

*Fineness of Wool (D 419-50 T).

*Determination of Small Amounts of Copper and Manganese in Textiles (D 377-50 T).

Methods of Testing:

Bonded Fabrics (D 1117-50 T).

Definitions:

*Terms Relating to Textile Materials (D 123-50 T).

Engine Antifreezes

(Committee D-15)

Specifications:

Hydrometer-Thermometer Field Tester for Engine Antifreezes (D 1124-50 T).

Methods of Test:

Reserve Alkalinity of Concentrated Engine Antifreezes (D 1121-50 T).

Specific Gravity of Concentrated Engine Antifreezes by the Hydrometer (D 1122-50 T).

Water in Concentrated Engine Antifreezes by the Iodine Reagent Method (D 1123-50 T).

Boiling Point of Engine Antifreezes (D 1120-50 T).

Ash Content of Concentrated Engine Antifreezes (D 1119-50 T).

Naval Stores

(Committee D-17)

Methods of Test:

Rosin Oils (D 1131-50 T).

*Water in Liquid Naval Stores (D 890-50 T).

Industrial Water

(Committee D-19)

Methods of Test:

Sodium and Potassium in Industrial Water (D 1127-50 T).

Electrical Conductivity of Industrial Water (D 1125-50 T).

Hardness in Industrial Water (D 1126-50 T).

Silica in Industrial Water (D 859-50 T).

*Total Carbon Dioxide and Calculation of the Carbonate and Bicarbonate Ions in Industrial Water (D 513-50 T).

Methods:

Identification of Types of Microorganisms in Industrial Water (D 1128-50 T).

*Identification of Crystalline Compounds in Water-Formed Deposits by X-Ray Diffraction (D 934-50 T).

Plastics

(Committee D-20)

Specifications:

*Melamine-Formaldehyde Molding Compounds (D 704-50 T).

*Molds for Test Specimens of Plastic Molding Materials (D 647-50 T).

Method of Test:

*Luminous Reflectance and Transmission Characteristics and Color of Plastic Materials (D 791-50 T).

Recommended Practice:

Injection Molding of Specimens of Thermoplastic Materials (D 1130-50 T).

Methods of Testing

(Committee E-1)

Methods:

Verification and Classification of Extensometers (E 83-50 T).

*Test for Brinell Hardness of Metallic Materials (E 10-50 T).

Actions on Standards Submitted to Members for Letter Vote

AT THE 1950 Annual Meeting in Atlantic City approval was given to submit to letter ballot of the Society proposals from the technical committees on 152 standards and tentatives. These proposals as listed on the letter ballot which will be mailed to the entire membership in July or early August, fall into two categories, namely, the adoption of tentative specifications and tests as formal standards, and the adoption of revisions in existing standards.

The letter ballot on the actions will be canvassed on September 15.

In connection with the actions on standards it should be noted that only by letter ballot of the entire Society membership can changes be made in the formal standards. The action in an annual meeting session alone or, in the interval between annual meetings, by the Administrative Committee on Standards (1) can approve for publication as *tentative* proposed new standards,

(2) can approve *revisions in tentative standards* (which are incorporated immediately), or (3) can take action to permit publication of *proposed revisions in standards as tentative*. Many such actions, of course, are taken at the Annual Meeting and throughout the year by the Administrative Committee on Standards.

A complete list of items to be voted upon appears in the letter ballot being sent in a separate mailing to the members. Detailed information concerning matters referred to letter ballot is given in the committee reports issued in preprint form to the membership in advance of the meeting. The *Summary of Proceedings* accompanying the letter ballot contains a record of all actions taken at the Annual Meeting.

All newly adopted and revised standards will be published in the 1950 Supplement to the six-part 1949 Book of A.S.T.M. Standards. The Supplements will be mailed to the members in

accordance with instructions on file at headquarters. Details of the Society's extensive publication schedule will be given in the September BULLETIN.

Conference on X-ray and Electron Diffraction

AT THE Eighth Annual Pittsburgh Conference on X-ray and Electron Diffraction to be held at Mellon Institute, November 2 and 3, 1950 sessions are tentatively being arranged for papers on Small-Angle Scattering, Instrumentation and Techniques, Applications in the Fields of Metals and Silicate Chemistry, and General Subjects.

Professor Andre Guinier will address the conference the evening of November 2, on the subject: "European Advances in High Intensity X-ray Diffraction."

Papers are invited on the above or related subjects. Titles should be sent to the Chairman of the Program Committee, Dr. L. J. Hofer, Bureau of Mines, Bruce- ton, Pa., before August 15, so that a preliminary program may be published. Submitted papers will be considered in the order in which they are received.

Notes on Annual Meeting Sessions and Committees

(Continued from page 11)

Metals in High-Temperature Service

can be of considerable magnitude and which become of great importance if the operation includes a large number of shutdowns or cycles of temperature or pressure. Microstructural changes during exposure at elevated temperatures may also have a deleterious effect upon the weld joint properties.

Mr. Eberle described a full-size proof test that was used with ferritic-austenitic weld joints. The specimen was maintained at 1100 F. temperature and 1500 psi. internal pressure. An 18Cr-8Ni steel with columbium, a 2½Cr-1Mo and a cast material, 16Cr-13Ni-2Mo were used. Welding electrodes were 19Cr-9Ni with columbium. Cracks were detected by radiographic means in the 2½ Cr-1Mo pipe at the edge of the weld joint after 4631 hr. at 1100 F. temperature and 1500 psi. pressure, involving 47 week-end shutdowns to atmospheric conditions. Metallurgical examination showed that the principal factors contributing to the failure were stresses up to yield strength due to differences in thermal expansion of the ferritic and austenitic materials, accelerated creep, intergranular stress-oxidation and weakening of the ferritic metal adjacent to the fusion zone due to carbon migration into the austenitic weld metal.

Many months of work, the services of numerous personnel, and other elements went into the extensive researches on which the paper by Messrs. Carpenter and associates is based. This paper relates to the metallurgical factors, the performance, and fabrication of dissimilar metal joints which may be employed in high-pressure, high-temperature steam service. It has been recognized that expansion stresses existing between a ferritic material and an austenitic material present some unknown problems in service. The expansion stress effects at dissimilar metal joints have led to the necessary consideration of other factors which were found to be present when a dissimilar metal weld is operating at high temperature, under high stresses in a cyclic manner. These are basically metallurgical ones. They are dependent upon the time, the temperature, and the combined stresses. Under some conditions, laboratory tests show that failure occurs in a carbon-

depleted region of the heat-affected zone of the weld. Cyclic conditions, oxide penetration, and metallurgical or mechanical notches as may occur under some operating or fabricating conditions, speed the time to failure. Failures of field welds of dissimilar metals under severe operating conditions are shown as examples. This work does not predict service life expectancy of dissimilar metal joints. Its object has been, first, to point out the potentiality of this type failure in service, and second, to find remedies which remove or lessen the possibility of failures in dissimilar metal welds in high-temperature service.

The author carried out rotating-beam fatigue tests on tubing and weld metal; numerous cyclic quench tests; a great range of other mechanical tests, yield point, ultimate strength, etc. In general, the test specimens were operated at service temperatures and pressures, with superimposed mechanical or thermal shocks. Full sections of superheater tubing were studied in a special fatigue machine which could take the sections.

For all those concerned with this important subject, a study of this paper when published later in the year might almost be considered a "must!"

At this time the conclusions given by the authors, with which leading authorities in the session seemed to concur are as follows:

It is difficult to estimate the degree of success to be expected of a dissimilar metal joint in service. The work reported here together with service experience points to several factors which when controlled will measurably reduce the possibility of failure:

1. The weld metal used may be either austenitic or ferritic, but each should demand an exacting control of the electrode itself and of the technique employed. This control should include careful shop tests of the electrodes to insure absence of fissuring. Careful procedures and welding details must be established. Welding techniques in production should be carefully controlled to assure removal of crater cracking or other mechanical defects. The cover beads should be removed flush to the surface and all other stress raisers such as notches and undercuts carefully removed when they are near the fusion line.

2. No post welding heat treatment need be given welds joining ferritic to austenitic materials when the ferritic material does not show as-welded hardnesses over 550 BHN, and when service temperatures exceed 950 F. This will reduce carbon depletion on the ferritic

side and will lessen the rate of sigma formation in the austenitic weld metal.

3. The choice of welding composition seems to be a 19Cr-9Ni-Cb electrode for most applications. The reasons for this are basically soundness and better high-temperature strength. A low-chromium, low-carbon electrode shows excellent possibilities, certainly for nonpressure parts or for pressure parts when more information on its high-temperature properties becomes available.

4. The fundamental cause of failure of a transition weld in a ferritic to an austenitic material is expansion and operating stresses. Other secondary causes such as oxidation fatigue, carbon migration, and poor welding techniques speed these failures. The safe operating limits to be expected of a dissimilar metal weld appears to be a function of the operating temperature and the degree of temperature cycling. This work points out that endurance limits of 2½ Cr-1Mo tubing welded with 19Cr-9Ni-Cb to 18Cr-8Ni-Cb tubing operating at metal temperatures of 1150 F., to be well beyond that to be expected in normal superheater service. This presupposes that the various welding and material precautions which have been suggested have been followed.

5. Where temperature and stress conditions are such as to indicate possible failure during the normal life of the assembly, it is recommended that all cyclic temperatures be prevented at dissimilar joints. This may best be accomplished by separate heating as, for example, by Calrods or by other similar methods, applied to the outside of the joint. These may automatically be controlled so as to prevent the cooling of the weld under the approximate operating temperature range.

In a pertinent discussion of this paper, Herman Weisberg, Mechanical Engineer, Public Service Electric & Gas Co., New Jersey, referred to other tests of less exhaustive nature which had been carried out. He made several references to the use of Kelcaloy transition joints. He said that as a result of this work joints of this type would no doubt be heated during shutdown periods.

Magnesium and Aluminum Alloys for Elevated Temperature Service

Three papers covering, respectively, magnesium-cerium cast alloys, magnesium-cerium wrought alloys, and aluminum-6 per cent magnesium alloys for elevated temperature service were presented by L. W. Eastwood of Battelle Memorial Institute at the Thirteenth Session covering Non-Ferrous Metals

and Spectroscopy. Experimental work in these papers was sponsored by the Air Technical Service Command, Wright Field, and by the Materials Branch, Airborne Equipment Division, Bureau of Aeronautics, Navy Department.

The designer and metallurgist are constantly seeking structural materials having improved strength-weight properties at the temperature of the part during service. Because of their low density and high strength at normal or slightly elevated temperatures, magnesium and aluminum alloys have been used in aircraft motors for a number of years.

During the experimental work for the paper covering magnesium-cerium cast alloys, a considerable amount of tensile and some creep data were obtained on alloy AZ63 (6 per cent aluminum, 3 per cent zinc), EM62 (6 per cent cerium, 1.8 per cent manganese), and on the alloy selected as having the optimum composition, which was 6 per cent cerium (rare earths), 0.8 per cent manganese, 0.2 per cent nickel, and 0.02 per cent tungsten. This alloy is very much finer grained than the EM62 composition, even when poured at high temperature into heavy sections. In addition it has high tensile properties at 600 F. and creep resistance equal to that of the EM62 composition. The alloy is finer grained than alloy E6 (6 per cent rare earths) and has substantially better tensile properties and creep resistance at 600 F.

In the second paper, covering magnesium-cerium wrought alloys, a systematic study was conducted by making tension tests at room temperature and at 600 F. and creep tests at 600 F. Manganese up to 1 per cent or better and cerium up to 2 per cent are very beneficial. The alloy of optimum composition appears to be 2 per cent cerium, 1 to 1½ per cent magnesium, and 0.2 per cent nickel. It is quite evident that this alloy is appreciably superior to alloy EM22 (approximately 1.6 per cent manganese and 2 per cent rare earths) or 18S or 22S alloys at 600 F. The third paper, covering aluminum-6 per cent magnesium alloys, reports that as a result of the work, the following composition was developed:

Magnesium.....	6 per cent
Manganese.....	1 per cent
Copper.....	1.5 per cent
Vanadium.....	0.1 per cent
Zirconium.....	0.25 per cent
Titanium.....	0.08 per cent
Beryllium.....	0.005 per cent
Aluminum.....	99.5 per cent, bal.

Such alloys have the advantages of not being seriously affected by stabilization at the temperature of test of 400 to 700 F. As a result, their tensile proper-

ties at 600 F. are high after stabilization at the test temperature. In addition, their density is low, their resistance to corrosion is excellent, and the machining characteristics are satisfactory. On the other hand, as compared with 142 alloy, the experimental alloy developed has somewhat poorer foundry characteristics. In addition, its thermal conductivity is substantially lower, which probably limits its use to applications where heat dissipation is unimportant. The creep properties of the experimental alloy are better than those of previously known 6 per cent magnesium alloys but somewhat inferior to 142 alloy. It is believed that additional improvement in the resistance to creep of the 6 per cent magnesium alloys could be obtained. If this were done, however, the load employed in the creep test should be raised from 1300 to 2500 psi. Under these conditions, improvements in resistance to creep produced by changes in the alloy composition can be more readily measured.

Considerable discussion on the three papers resulted, including comments from the Canadian Bureau of Mines and the Aluminum Research Laboratories in England.

Corrosion of Ferrous and Non-Ferrous Metals, Cast Iron, Water

The Twenty-Second Session; in addition to the three papers on corrosion, included a paper by J. T. Richards and E. M. Smith on "The Forming Characteristics of Beryllium Copper Strip." In this paper the effects of temper, stock thickness, grain size, and grain direction upon formability and miscellaneous design or specification properties were noted. The best combination of formability and tensile properties was obtained from material having a relatively fine grain structure.

T. P. May and A. L. Alexander presented two papers jointly, the first of which pointed out the results of their investigations into the use of natural sea water, synthetic sea water, 3 per cent sodium chloride solution, and 20 per cent sodium chloride solution. At the same time corrosion tests were conducted in the natural environments at Kure Beach, North Carolina. The tests revealed little similarity in performance between the natural environments and the spray cabinets using 3 and 20 per cent sodium chloride solutions. From the data shown in their second paper it appears that the use of synthetic sea water is justified as a test medium in lieu of genuine sea water for use in salt spray testing. In the evaluation of organic coatings applied to ferrous surfaces, 3 per cent brine was the most severe of the solu-

tions investigated. Close agreement was obtained between replicate samples throughout the studies.

A. H. Woodcock, in his paper on "Atmospheric Sea-Salts and Corrosion," gave data showing the weight and number of sea-salt particles which have been sampled in marine air. Many of these nuclei impinge upon and adhere to surfaces as large as the 10 by 15-cm. test plates commonly used in corrosion studies. The rate of accumulation varied from 2.6 to 24.1 mg. per sq. cm. per day, the amount varying with distance from the edge and with the angle of exposure to the wind.

Fatigue Testing

The five papers presented at the Session on Fatigue Testing covered steel, aluminum, and copper. The paper by L. P. Tarasov and H. J. Grover showed on hardened steel that (1) gentle grinding gave endurance limits as high as gentle grinding followed by careful polishing, (2) severe grinding reduced the endurance limits roughly 20 to 25 per cent, and (3) either tumbling or shot peening after grinding greatly increased the endurance limits.

"Effect of Chromium Plating on the Endurance Limits of Steels Used in Aircraft" by H. L. Logan indicated that chromium plating reduced the endurance limits of both normalized and hardened S.A.E. X4130 steels. The reduction was greater for the hardened steel.

G. W. Stickley and F. M. Howell, in their paper, "Effects of Anodic Coatings on the Fatigue Strength of Aluminum Alloys," drew the following conclusions: (1) thin anodic coatings (about 0.0001 in. thick) on smooth surfaces have little if any effect on the fatigue strength of aluminum alloys, (2) thick anodic coatings (about 0.0003 to 0.0005 in. thick) on smooth surfaces seem to have slightly detrimental effects at higher stresses, but no shortening of fatigue life has been noted at stresses below 17,000 psi., and (3) since anodic coatings 0.0001 and 0.0005 in. thick were found to have no harmful effect on the fatigue strength of 75S-T6 alloy specimens with sharp notches machined in them before anodizing, it appears that aluminum alloys in the presence of severe stress raisers are not adversely affected by anodic coatings.

Joseph Marin, J. H. Faupel, and L. W. Hu concluded in their paper, "Combined Tension-Torsion Creep-Time Relations for Alcoa 2S-O," that the minimum constant creep rates for various values of the stresses and for ratios of the biaxial principal stress from 0 to -1.0 were in approximate

agreement with values predicted theoretically using simple tension-creep test results.

The final paper in this session—that by John N. Kenyon on “The Reverting of Hard-Drawn Copper to Soft Condition Under Variable Stress”—pointed out that endurance tests carried out on long lengths of hard-drawn copper wire developed “islands” of soft copper at the periphery. This reverting to large crystals was found to occur in some 30 per cent of the heats tested at room temperature and in all the heats tested at 70 C. It is believed that many transmission line failures attributed to a mechanical defect in the wire are a direct result of this softening phenomenon.

Nondestructive Testing

Nondestructive methods are being looked to more and more as solutions to inspection problems. They have advantages in that *they test parts that actually go into service*; they permit theoretically at least greater coverage; they may be fitted more easily into manufacturing patterns and they are in many cases more economical. The symposium on the Role of Nondestructive Testing in the Economics of Production was developed to bring out some of these practical aspects of various kinds of nondestructive testing and to suggest applications in new fields. It should focus attention on the greater potential value to industry of such methods and the necessity of further development of them.

The well-attended (average 150 per session) symposium was sponsored by Committee E-7 on Non-Destructive Testing, and the chairman and co-chairman of the morning session were H. H. Lester and L. H. Winkler, respectively. R. C. McMaster and S. A. Wenk presented a paper entitled “A Basic Guide for Management’s Choice of Nondestructive Tests.” Extremely well prepared, this paper summarized the basic principles and essential parts of nondestructive tests. The significant features of 12 basic test methods were also described from reviews previously made of more than 250 patents and approximately 500 technical articles. The nature and critical features of non-destructive tests were discussed with reference to existing commercial instruments and the principle of operation of each test method was briefly stated. In the paper the patented test methods were classified by the nature of the energy field established in the test object, or by the method of measurement. Those covered included electric current conduction; electromagnetic induction;

magnetic and electric field; thermal; penetrating radiation; mechanical vibration; luminous energy; pressure, leak, and penetrant; mechanical caliper or gage; chemical spot; and triboelectric non-destructive tests.

K. R. Van Horn spoke on the defects or discontinuities revealable in cast and wrought metal products by nondestructive tests, illustrating his talk with remarkable slides which completely pictured all the various defects. These illustrations were of a quality which would enable quick intelligible interpretation of results of nondestructive tests.

J. W. Juppenlatz discussed “The Role of Nondestructive Testing in the Economics of Castings.” Speaking of design, it was mentioned that only a few years ago, castings (other products too) were designed with factors of safety of about 6 to 8. Today new designs are made with safety factors of 3 to 4 and some of 1.2. Better materials without harmful defects or faults helped to bring about these drastic changes. Using nondestructive methods intelligently interpreted on newer, stronger and lighter casting alloys helped to allow the lowering of these safety factors and at the same time the cost of units constructed of these alloys. The use of nondestructive testing has indirectly carried a significant burden toward the fulfillment of our aeronautical progress—these tests have made possible our present-day airplanes.

The more common inspection methods in use today were briefly discussed with relation to the effects on foundry operations, final mechanical processing and ultimate cost of casting products. Mr. Juppenlatz said that effective inspection should be of orderly sequence employing the least costly inspection procedure first and as frequently as needed during processing. Other methods of inspection may follow which are more substantial and searching in nature, but these further inspections should not be conducted on castings with harmful defects previously disclosed. Certainly the timing of inspection during operations has a direct relation to the ultimate casting cost of inspection proper. The sequence named was in the order of visual inspection, penetrant and magnetic particle tests, radiographic tests, low-pressure hydrostatic tests, and service tests. The latter are final proof of quality built into the product which should be sufficient to render unfailing service during its normal expected life.

The afternoon session was under the chairmanship and co-chairmanship of R. C. McMaster and J. R. Trimble, respectively.

W. L. Schwinn presented a paper on “Economical and Practical Application of Cobalt-60 in the Radiographic Inspection of Steel Weldments.” Experimental work was conducted to compare this new gamma radiation source with gamma rays from radium and X-rays from a practical standpoint in regard to sensitivity, exposure, time, economics, and technique. Under comparable conditions for reasonable applications, Cobalt-60 was found to have distinct advantages. The radiographs studied were in a range of plate thickness from 1 to 4 in. The relative sensitivity of the various sources and the exposure time data were presented in chart form. The economics was considered on the basis of relative cost for other sources of radiation and equipment and summarized as a cost of testing by each source per unit produced. Again Cobalt-60 appears to have an economic advantage in some cases. Several techniques in the practical application of Cobalt-60 as a radiation source in the radiographic inspection of steel weldments were outlined.

C. D. Moriarty in his paper on “The Economics of Wrought Steel Inspection” spoke of the “right test at the right time.” The economic value of nondestructive testing to the wrought steel user was discussed and emphasis was placed on the point of using non-destructive methods early on the relatively unfinished materials so that defective parts can be thrown out and thus a major saving be made in man-hours. Discussion in greater detail was presented on the part that ultrasonics in the testing of material in motion, has in the saving of man-hours. These methods are particularly adaptable to the testing of wrought steel in the early stages of the manufacturing cycle.

L. W. Ball spoke on “The Economics of Special Inspection Problems,” pointing out that the testing engineer should not neglect his definite responsibility to management in the consideration of possible applications of nondestructive testing to inspection problems.

Following each paper and also at the end of the symposium there were stimulating discussions. Dr. McMaster, in the afternoon, and Dr. Lester, in the morning, both capably guided and summarized the progress of the symposium, calling upon many of those in attendance who in all cases were able to contribute valuable comment on the various nondestructive testing papers which had been presented.

Concrete and Building Materials

Grouped in two sessions on June 29 and 30 were several papers on concrete, concrete aggregates, surface water-proofers, cement base paints and damp-proofers, quicklime, and thermal conductivity apparatus.

A paper by A. Kline, D. Pirtz, and M. Polivka, University of California, described two methods for determining the air content of hardened concrete, one being an absolute-volume method and the other a vacuum-saturation method. J. R. Leslie, Hydro-Electric Power Commission of Ontario, discussed dynamic testing using pulse techniques. Nondestructive testing in many solids is facilitated by the use of this technique. Katherine and Bryant Mather, U. S. Waterways Experiment Station, presented a detailed outline of the method for petrographic examination of aggregates for concrete as used by the concrete laboratories of the Corps of Engineers. F. O. Anderegg, John B. Pierce Foundation, discussed additional field studies on surface waterproofings. This paper is a follow-up to a previous paper presented at the 1948 Annual Meeting covering methods of testing surface water-proofers. A paper was presented by W. N. Spurgeon, American Fluoresit Co., describing tests made on 23 commercial cement paints. The theory of dampproofing was discussed briefly and the need for further development of a simple screening test to supplement weathering data for cement base damp-proofers, as well as specifications for these materials, is pointed out.

Test results and conclusions were given in a paper on the effect of time and temperature of burning on the properties of quicklime prepared from calcite by J. A. Murray, H. C. Fischer of M.I.T., and D. W. Sabean of New England Lacquer Co. Among the conclusions it was shown that porosity, surface area, and activity of quicklime prepared from calcite are closely related. Automatic control of thermal conductivity apparatus is described by E. M. Herrmann, R. B. Plate, and W. P. Sinclair, U. S. Naval Engineering Experiment Station. This automatic control has been applied to pipe testing apparatus and to the guarded hot plate apparatus.

Triaxial Testing—Identification and Classification of Soils

Two sessions, morning and afternoon of June 28, were required to present the several papers with discussions in the symposium covering methods of testing soils under triaxial loading. These papers discuss the application of this method of testing to soil specimens as

well as to bituminous pavements. In the morning session there were papers by E. B. Hall, Corps of Engineers, describing the construction and operation of a triaxial apparatus for testing soils containing material passing the 3-in. sieve size; S. J. Johnson, Waterways Experiment Station, reviewing the types of shear tests performed by the soils laboratory of the station; D. W. Taylor, M.I.T., discussing investigations of shearing strengths of soils taken from the site of a molded flood wall for the Corps of Engineers; A. A. Wagner, Bureau of Reclamation, presenting shearing characteristics of several earth materials remolded and placed at different densities and moistures; and D. M. Burmister, Columbia University, discussing the behavior characteristics of soils under stress and a recognition and comparison of the nature of the controlling conditions inherent in natural situations that may dominate and control actual behavior of soils.

The afternoon session, applying more specifically to pavements, included papers by H. E. Worley, State Highway Commission of Kansas, containing a comprehensive discussion of test data and field performance on the application of triaxial testing to flexible pavement design; E. S. Barbor and C. L. Sawyer, Bureau of Public Roads, discussing the effect of certain variables in equipment and procedure and the influence on results obtained in the triaxial compression tests; R. J. Hank, Texas Highway Department, gave reasons for triaxial testing with a brief discussion on the background of the procedure and the application of the test data to the design of flexible bases and to the analysis of foundation problems; H. E. Davis and F. N. Hveem, University of California and California Division of Highways, respectively, summarizing the views of an informal group of west coast engineers organized under the name of the Triaxial Institute clarified concepts pertaining to triaxial compression testing and the application of the triaxial type of test to design and control problems related to pavements and subgrades; and N. W. McLeod, Ottawa Department of Transportation, outlined the use of a triaxial test for the rational design of bituminous paving mixtures giving data for determining the influence of frictional resistance between pavement and tire and between pavement and base on the stability of bituminous pavements.

An evening session on June 29 contained five papers dealing with the identification and classification of soils. This group of papers formed a symposium which will ultimately be published as a companion to the Procedures for

Testing Soils. D. M. Burmister, Columbia University, gave an appraisal of the present situation with regard to the nature and causes of confusion in soil identification, and the principles and respective roles of both identification and classification in soil and foundation work. E. A. Abdun-Nur, Bureau of Reclamation, outlined the soil classification system used by the Bureau which is based on Casagrande's airfield classification. This system classifies soils on the basis of performance. W. F. Abercrombie, Georgia State Highway Department, discussed the needs of a classification system referring to one initiated by the Highway Research Board for subgrades which is patterned after the system promulgated by the Bureau of Public Roads. A summary was given of the number of state highway departments using this classification system which basically classifies according to granular and silt-clay materials. E. A. Willis, Bureau of Public Roads, described the development of soil classification methods now being used by the Bureau citing the engineer soil map as a particularly suitable means for the dissemination of information gained by soil surveys, laboratory testing, and the interpretation of air photos and pedologic and geological maps. E. J. Felt, Portland Cement Association, reviewed the soil identification and classification procedures used by the U. S. Dept. of Agriculture, Division of Soil Survey. The value of soil names is emphasized in this paper.

One additional paper, not a part of either of the two symposiums just described, was presented by D. Berdan and R. K. Bernhard, Rutgers University. This paper dealt with pilot studies of soil density measurements by means of X-rays. It is felt that X-ray technique to measure qualitatively and quantitatively changes in density of soil samples is satisfactory, but further investigations are needed to correlate differential pressure cell output with certain effects due to soil compaction produced by static and dynamic loads. Radioactive isotopes (Cobalt-60) appear to possess possibilities in further applications of the radiographic method in this field.

Plastics, Adhesives

Apart from the report of Committee D-20 on Plastics which indicated a very active and productive year, several significant papers were presented at this session.

The first of these, by R. H. Carey (See p. 56) of the Bakelite Division, Union

Carbide and Carbon Corp., discussed the "Stress Cracking of Polyethylene." This included the effects of various environments upon the tensile properties of polyethylene and showed that the change in mechanical properties is greatly accentuated by fluids such as alcohols and toluene. This phenomenon is compared to "stress corrosion cracking" as observed in metals where cracking occurs in mildly corroding environments.

The properties of polyethylene are compared with older more common materials. It is shown that polyethylene is not a "rubber-like" or "elastomeric" material but more nearly resembles some non-ferrous metals. This comparison is inferred from its crystalline structure, stress-strain diagram, and "stress corrosion cracking" phenomenon.

Two papers were sponsored by the New York Naval Shipyard and the Bureau of Ships. The first of these, by Fried, Winans, and Sieffert dealt with "Effects of Elevated Temperatures on Strength of Thermosetting Plastic Laminates." This paper presented the results of an extensive study of the progressive effects of high-temperature conditioning on the flexural and compressive strengths of a glass-melamine and two different types of phenolic laminate. Tests were conducted at elevated temperatures ranging from 50 C. through 250 C after conditioning

periods of from 1 through 768 hr. (32 days). Methods and special equipment for making measurements at high temperatures are described in detail.

The second paper, by Yustein, Winans, and Stark, entitled "Outdoor Weather Aging of Plastics Under Various Climatological Conditions" outlined a program and gave preliminary results of a very extensive study of outdoor weathering. Five climatological regions are represented in the program which provides for outdoor exposures on sites located in (1) Panama Canal Zone (tropical); (2) New Mexico (dry desert); (3) New York Naval Shipyard (temperate); (4) Fort Churchill, Manitoba, Canada (subarctic); and (5) Point Barrow, Alaska (arctic). The report covers exposures for 1, 3, 7, and 12 months. Subsequent reports will cover 18-, 24-, 30-, and 36-month exposures.

The materials dealt with in this report include five types of clear transparent sheet plastics, six types of laminated materials, and five types of molded terminal bars. The sheet materials are evaluated after each period of exposure for tensile and flexural properties, hardness, and dielectric constant and power factor. The electrical properties are determined for frequencies of 60, 1000, and 10⁶ cycles. The transparent materials are evaluated also for light transmission and haze. The molded terminal bars are evaluated for insula-

tion resistance, dielectric strength, and high-impact (HI) shock resistance.

Following the presentation of the report of Committee D-14 on Adhesives, a comprehensive paper on "The Measurement of Dynamic Modulus in Adhesive Joints," a contribution from the Massachusetts Institute of Technology, was presented, the authors being Dietz, Kavanagh, Closmann, and Rosen. This paper described a method that had been developed to measure, nondestructively, the dynamic modulus of an adhesive in the bond.

The equipment for obtaining the necessary resonance properties, the resonant frequency and half-power bandwidth, consists of three major parts: a driving system to set up longitudinal ultrasonic vibrations in the specimens, a detecting system to indicate the amplitude of vibrations, and a frequency measuring system.

Measurements have been made on stainless steel bar specimens, cemented with a phenol-formaldehyde polyvinylbutyral adhesive, which have been subjected to various heat treatments. The results of this study indicate that the measured dynamic modulus is useful for selecting from a group of treated specimens those which have deteriorated and have low tensile strength.

The method described is applicable to cemented-bar specimens composed of other types of bars and adhesives.

COMMITTEE NOTES

The following notes are intended to give some idea of the major accomplishments and activities of the various technical committees as reported at the Annual Meeting.

The notes are in order of the serial designation of the committees, "A" group first, "B," etc. Some of the "E" work is of direct interest to the other groups.

No attempt has been made to cover every committee, but the Staff did note most of the high lights of the work accomplished and under way. This and succeeding BULLETINS will continue to carry news of committee activities—in particular, from committee meetings, in the regular Technical Committee Notes section. See p. 47.

Changes in Committee Reports

While a number of the reports of committees were presented at the Annual Meeting interspersed with technical papers in the appropriate technical sessions, for the most part the committee reports were presented in several sessions, near the close of the meeting, devoted almost exclusively to the committee reports. Principal recommendations on which actions were taken are set forth in the committee notes appearing below, but for convenience the following listing is given of major changes with respect to recommendations in the committee reports.

Committee A-1 on Steel.—The recommen-

dation to adopt as standard nine structural steel specifications A 6, A 7, A 94, A 113, A 141, A 195, A 242, A 283, and A 284 was withdrawn in order that further study be devoted to the specifications. The revisions recommended, however, were accepted and the specifications as revised will be continued as tentative.

Committee A-7 on Malleable-Iron Castings.—The recommendation covering the adoption as standard of the Tentative Specifications for Malleable Iron Flanges, Pipe Fittings and Valve Parts (A 277) was withdrawn by the committee and the specifications are to receive further consideration during the year.

Committee C-1 on Cement.—With the

approval of the Executive Committee of the Board of Directors, Committee C-1 submitted a new recommendation not in the report as preprinted covering a minor revision of Specifications C 150 for Portland Cement, which will clarify footnote c for Table II.

Committee D-2 on Petroleum Products and Lubricants.—The recommendation to adopt as standard the Tentative Method of Test for Foaming Characteristics of Crankcase Oils (D 892) was withdrawn.

Committee D-9 on Electrical Insulating Materials.—The recommendation being made jointly with Committee D-20 on Plastics covering the publication of a new Tentative Specification for Cellulose Acetate Sheet and Film for Electri-

List and Designations of New Tentatives

A complete list of the new tentative specifications and tests and some of the more extensively revised tentatives, including the complete serial designations, appears on page 21. Members may wish to refer to this list when they review the statements on some of the highlights of the technical committee activities. In this accompanying text material, no serial designations for the new tentatives are given, and in some cases the titles are shortened. Consult the list on page 21 for complete titles and serial designations of new tentatives.

cal Insulation was withdrawn, Committee D-20 concurring in this action.
Committee D-17 on Naval Stores.—The recommendation covering the adoption as standard of the Tentative Method of Test for Saponification Number of Rosin (D 464) and the Tentative Method of Test for Acid Number of Rosin (D 465) was withdrawn and the methods are to be continued as tentative with revision.
Committee D-20 on Plastics.—The recommendations that Tentative Method of Test for Weight Loss of Plastics on Heating (D 948) and Tentative Specification for Methacrylate Molding Compounds (D 788) be adopted as standard were withdrawn.

"A" Group

Committee A-1 on Steel

In its annual report Committee A-1 proposed that nine of its structural steel specifications be advanced to a standard status with revision. On the request of the A.R.E.A. and the A.A.S.H.O. the action advancing Specifications A 6, A 7, A 94, A 113, A 141, A 195, A 242, A 283, and A 284 to standard was withdrawn in order that further study by these two Societies could be devoted to the specifications.

A special group has made recommendations covering proposed revisions in Specification A 131 - 49 T covering Structural Steel for Ships to bring it in line with the present requirements for ship steel. It is also being proposed that a new grade be added to Specification A 284 for Low and Intermediate Tensile Strength Carbon-Silicon Steel Plates for Machine Parts and General Construction to satisfy more fully the bridge engineers' requirements when ordering steel for welded shoes and similar weldments. A small group has been appointed to study the desirability of this proposal.

Last year Committee A-1 balloted

upon a recommendation to revise Specifications A 125 for Heat-Treated Steel Helical Springs. Although the balloting was favorable in regard to the proposed revision, there were several negative votes cast, based on objections to revised tolerances on uniformity of pitch and squareness of ends. Before passing the recommendation on for Society approval, Committee A-1 asked its Subcommittee IV on Spring Steel and Steel Springs to give every consideration possible to the negative votes. Subcommittee IV, during the past year, has collected evidence and factual data on spring performance with respect to these two points, including statistical analysis of test records, photographs of springs loaded and unloaded, sample springs, and discussion of the mathematical theory. Membership of Subcommittee IV, after viewing the evidence which was made available at the meeting in Atlantic City, approved a revised recommendation as presented, and it is expected that Specifications A 125 will be reverted to a tentative status with numerous revisions during 1950.

It is proposed to add to Standard Specifications A 305 covering Minimum Requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement a series of bar number designations to replace the former size designations and to incorporate explanatory notes clarifying the size equivalents of the bar numbers. This action will bring A 305 in conformity with Simplified Practice Recommendation R 26 of the U. S. Bureau of Standards and with practices unanimously recommended by producer interests. Subcommittee V on Steel Reinforcement Bars is also recommending various revisions in Standard Specifications A 15 - 39 covering Billet Steel Bars for Concrete Reinforcement, including the incorporation of the present tentative revision into the body of the specification. This puts into effect the work of various research groups in developing a new standard high type bond bar which has long been the search of designers. This action has the enthusiastic endorsement of large engineering groups representing both consumers and producers. Also to clarify the interrelation of Specification A 15 and A 305, it is proposed to broaden the scope clause of A 15 to define a deformed bar as that conforming to the requirements of Specification A 305, and further to clarify the new numbered designation of bars by introducing a table of numbered designations of bars and the corresponding dimensional value of those bars in accordance with Simplified Practice Recommendation R 26. Standard Specifications A 16 covering Rail Steel Bars and A 160 covering Axle Steel Bars will be revised in a similar manner to A 15. With the revisions, all four of these standards will be reverted to a tentative status.

Subcommittee VI on Steel Forgings and Billets displayed at its meeting a series of photomicrographs to illustrate the defects listed in Tentative Method A 317 for Macroetch Testing and Inspection of Steel Forgings. Excellent

progress has been made on this difficult problem of assembling such a series of photomicrographs, but it was felt that additional time should be permitted for improvement of this series before any official action is taken toward incorporating the photomicrographs in Methods A 317. Other work under way in the subcommittee includes the preparation of the proposed method for ultrasonic testing of steel forgings, a revised draft of Specification A 266 for Alloy Steel Seamless Drum Forgings, and a new specification to cover forged cylinders made by drawing or piercing. This latter specification has been suggested by the A.S.M.E. Boiler Code Committee.

The marking clause in Specifications A 53 for Welded and Seamless Steel Pipe is proposed for revision to clarify particularly the marking for acid Bessemer steel. A survey of the tube producing industry has indicated that equipment for manufacturing lap-welded steel or wrought iron boiler tubes is no longer available in the United States. Therefore, it is being recommended that all reference to lap-welded tubes be deleted from Specifications A 83. It has also been requested to include types 310 and 309 austenitic steels in Specifications A 213 covering Seamless Alloy-Steel Boiler and Superheater Tubes. The chemical compositions proposed for these two grades includes a carbon content of 0.15 per cent maximum.

A favorable letter ballot has resulted in Committee A-1 on the rearrangement of the boiler plate specifications developed by Subcommittee XI on Steel for Boilers and Other Pressure Vessels. In this new form the specifications for individual products include only those recommendations which are applicable to the particular product. The individual specifications refer to a general requirement specification titled General Requirements for Delivery of Rolled Steel Plates of Flange and Firebox Qualities (to be assigned the designation A 20) for requirements generally applicable to boiler plate specifications. This rearrangement will be submitted to the Administrative Committee on Standards for approval by the Society during 1950. Approaching final form is a specification for 4 to 6 per cent chromium, $\frac{1}{2}$ per cent molybdenum steel boiler plate. Requirements for a grade of boiler plate containing 1 per cent chromium, $\frac{1}{2}$ per cent molybdenum is to be added to the present Tentative Specifications A 301 as a new grade of material. There has been some discussion in Subcommittee XI and in Committee A-1 as to the proper method for including a requirement for copper content when copper steel is ordered to Tentative Specification A 285. The proposal submitted at Atlantic City to Subcommittee XI is that a requirement shall be placed in Specification A 285 giving both a minimum and a maximum copper requirement when copper steel is order to this specification.

At a meeting of Subcommittee XV on Bar Steels it was decided that Specifications A 304 covering Alloy-Steel Rounds

Suitable for Oil Quenching to End-Quench Hardenability Requirements needs drastic revision and a small group was appointed to draft a new edition of this specification for consideration at the next meeting. It is expected that a new tentative specification for cold-finished alloy steel bars will be published by the Society within the next year. Just getting under way is work on a proposed specification for alloy-steel bars for nitriding.

Late in 1949 a revision in Tentative Specifications A 217 covering Alloy-Steel Castings Suitable for Fusion Welding for High-Temperature Service was approved by the Society. The revised Specifications A 217 now covers only seven grades of ferritic steels. To cover grades of austenitic steels formerly included in A 217 and also covered now in Tentative Specifications A 157 for Alloy Steel Castings for Valves, Flanges, and Fittings for High-Temperature Service, a new specification is being developed. In addition another specification covering grades WC7 and WC8 ferritic steels dropped from Specification A 217 and other similar grades is being worked upon. Two other specifications are in their formative stages, one covering fusion-welded alloy steel pipe for high-temperature service and the other covering austenitic alloy steel welding fittings. In regard to the two new specifications being developed for austenitic steel castings and welding fittings, these grades of steel will be included in present specifications if at all possible and given appropriate grade designations.

There was some discussion at the meeting of the Advisory Group of Committee A-1 as to the need for specifications covering alloy steel chain. The authority was given to the chairman of Committee A-1 to form a special subcommittee to investigate the need for such a specification and to report back to the Advisory Group.

Committee A-5 on Corrosion of Iron and Steel

Committee A-5, subsequent to the 1949 Annual Meeting, presented to the Society through the Administrative Committee on Standards the following recommendations: The new Tentative Specifications for Zinc-Coated (Galvanized) High Tensile Steel Telephone and Telegraph Line Wire (A 326 - 49 T) and the revision and reversion to tentative of Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Telephone and Telegraph Line Wire (A 111 - 43). The committee also recommends revision of the following tentatives: Zinc-Coated (Galvanized) Iron or Steel Sheets, Coils and Cut Lengths (A 93 - 48 T), and Long Terme Iron or Steel Sheets, Coils and Cut Lengths (A 308 - 47 T) to include material coated in coils.

Appended to the report of Committee A-5 is the final report of the Subcommittee on Total Immersion Tests, the report of Subcommittee XIV on Inspection of Black and Galvanized Sheets, Subcommittee XV on Field Tests of Wire and

Wire Products, and Subcommittee XVI on Field Tests and Inspections of Bare and Metallic-Coated Hardware, Structural Shapes, Plates, Bars, and Their Products. These inspection reports are always received with considerable interest in view of the valuable exposure data contained.

Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys

Committee A-10 reported that, subsequent to the 1949 meeting, the Administrative Committee on Standards had accepted the recommendations for revisions in Tentative Specifications for Corrosion-Resistant Iron-Chromium and Iron-Chromium-Nickel Alloy Castings for General Application (A 296 - 49 T), and Heat-Resistant Iron-Chromium and Iron-Chromium-Nickel Alloy Castings for General Application (A 297 - 49 T). The committee also recommends for immediate adoption revision of Standard Specifications for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing (A 270 - 47).

The committee announced the publication of two books since the last meeting: "Symposium on Tests for Stainless Steels" (STP No. 93) and "Data on Corrosion- and Heat-Resistant Steels and Alloys—Wrought and Cast" (STP No. 52A).

Subcommittee VI held a lengthy meeting on sigma phase at which time the results of various cooperators working in this field for the past four years were discussed.

Committee A-10 is inaugurating work to determine the effects of substituting columbium-tantalum for ferro-columbium in specifications containing limits for ferro-columbium. This is due to the decreasing availability of this material and the necessary substitution of columbium-tantalum.

"B" Group

Committee B-2 on Non-Ferrous Metals and Alloys

During the past year Committee B-2 submitted through the Administrative Committee on Standards revisions in ten tentative specifications for nickel and nickel alloy products. This is considered to be a major achievement on which the committee has long been at work.

The Subcommittee on coated metals is continuing its study of lead-coated copper sheets with an aim to providing certain methods of test for continuity of coating. The committee has received several requests to prepare specifications for tin and titanium and consideration is being given to undertaking work in these fields.

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys

Committee B-3 reported completion of an active year of work. Study of the salt spray test, as well as the acetic acid-salt spray test is continuing. The results of tests using different kinds of salt spray,

Survey of Current Standardization Projects in September Bulletin

An extensive survey of current standardization projects under way in technical committees will appear in the September BULLETIN.

This survey achieves several purposes. It acquaints the Society officers, the various administrative committees, and the Staff with the standardization work that is under way, and it informs the respective committee officers with work under way in other groups, and thus tends to avoid overlap. Perhaps of paramount importance is that the published summaries afford members a "look ahead" on the specifications and tests which are being developed in the large number of committees.

including natural and artificial sea water, were topics of two papers sponsored by the committee and presented at the Twenty-Second Session.

The exposure programs of the various subcommittees are quite active—those specimens of Subcommittee VI at La Jolla, Calif., were removed from that site and are currently being cleaned, weighed and tested for tensile strength. Calibration specimens of zinc and steel have been exposed at several of the A.S.T.M. atmospheric exposure sites. Part 1 of Subcommittee VIII's galvanic and electrolytic corrosion program has been placed on exposure. The final exposure of these disk-type couples was made at State College in May. Preparation of Part 2, spool-type specimens, and Part 3, plate-type specimens of this program, is under way.

Committee B-4 on Electrical Heating, Resistance, and Related Alloys

Committee B-4 has been extremely active in the past year as evidenced by the fact that they recommended 13 tentatives be approved for adoption as standard. During the year the Administrative Committee on Standards has accepted their Tentative Specifications for Circular Cross-Section Cathode Sleeves for Electronic Devices (B 239 - 49 T).

Prominent in the year's activity was the publication (in the October, 1949 ASTM BULLETIN) of the paper by A. deS. Brasunas and H. H. Uhlig, "Some Observations on the Accelerated A.S.T.M. Life Test for Electrical Heating Wires."

Subcommittee V on alloys for high-temperature use is considering a method of test for intermittently heating and cooling specimens automatically, in relation to oxidation.

Subcommittee VII is studying the problem of hardness testing and an extensive field test program is nearing completion which it is hoped will lead to specification status in the near future.

The Proposed Tentative Method of Test for Relative Thermionic Emissive Properties of Materials Used in Electron Tubes, appended to the committee's report, covers a procedure for determining the comparative merits of various radio tube materials based on their effect on electrical characteristics of a typical standard diode. A tentative method of sag testing, has also been developed, as well as a specification for a non-ferrous metal for metal-to-glass seals. In addition, the committee is studying the effect of "green rot" and a method of test for determining hardness of contact materials is nearing completion.

Committee B-6 on Die-Cast Metals and Alloys

Committee B-6 recommended that the Tentative Specification for Aluminum-Base Alloy Die Castings (B 85 - 49 T) be revised to change the maximum limit of zinc in alloys SC5 and SC6 from 0.6 per cent to 1.0 per cent. The committee also recommended that the Tentative Specifications for Copper-Base (Brass) Alloy Die Castings (B 176 - 49 T) be approved as standard.

Subcommittee V on Exposure and Corrosion Tests has completed the testing of the magnesium-base and zinc-base alloys exposed at five outdoor and three indoor sites for ten years. The results are appended to the report of the committee.

Task groups of Subcommittee IX on Die-Casting Processes are making progress with the design of a test casting die for hot- or cold-chamber casting of zinc alloys and have also developed a satisfactory method for measuring metal pressures within the test casting die.

Committee B-7 on Light Metals and Alloys, Cast and Wrought

Subsequent to the 1949 Annual Meeting, Committee B-7 submitted through the Administrative Committee on Standards a Tentative Method of Measuring Thickness of Anodic Coatings on Aluminum by Means of the Filmeter (B 244 - 49 T). The committee is also recommending the acceptance of the proposed Tentative Specifications for Aluminum Alloy Die Forgings appended to the committee report. For the purpose of this specification, a die forging is one brought to its final shape in recessed dies and has a maximum thickness of 4 in.

The Special Subcommittee on Atmospheric Exposure Testing expects to have the collection and preparation of test specimens completed and on exposure by March, 1951. The exposure will definitely be made at five locations, namely, New York City, Kure Beach, Port Aransas, Point Reyes, and State College and specimens may also be exposed at Columbus, Ohio.

Committee B-8 on Electrodeposited Metallic Coatings

The report of Committee B-8 showed considerable activity among the various

subcommittees. Work is currently in progress on effective thickness of chromium on thin nickel coatings over copper alloys with respect to stress cracking of the nickel deposits. Supplementary exposure panels have been added to the copper-nickel-chromium group, including chromium and nickel-chromium deposits on rolled nickel sheet and copper-nickel-chromium deposits on high-carbon steel. Progress is also being made in developing photographic standards to aid in inspecting the panels. There have been prepared or are being prepared recommended practices for preparation of zinc-base die-castings for plating, preparation of copper and copper alloys for electroplating, preparation of and plating on stainless steel, preparation of aluminum for electroplating, preparation of plastics for electroplating, plating on lead and tin and their alloys, and plating on cast and malleable iron. Exploratory outdoor exposure study has been completed and plans formulated for a more extensive program investigating five types of chromate treatments exposed to various atmospheres as well as accelerated conditions.

Joint Committee on Effect of Temperature on the Properties of Metals

THE tremendous activity in the Joint Committee on Effect of Temperature on the Properties of Metals, which is sponsored jointly by the A.S.T.M. and the A.S.M.E., is evident by the large part it had in the Annual Meeting technical program where it sponsored two technical symposiums and numerous other technical papers, and also through one of its Panels arranged for a round-table discussion. The Symposiums on Corrosion and Erosion of Gas Turbine Materials and on Effect of Sigma Phase on High-Temperature Properties resulted from Joint Committee activity, as did the Round-Table Discussion on Forgings for Gas Turbines. Other papers in the Ninth Session on Effect of Temperature and in the Fourteenth Session involving Steel, were stimulated by the Joint Committee work. One of the papers on "The Joining of Dissimilar Metals for High-Temperature Service," by Messrs. Carpenter and others of Babcock & Wilcox was an outstanding contribution of intense interest to all those concerned with power plants.

Another evidence of the great amount of activity in the Joint Committee is the decision to undertake a financial program involving some \$75,000 to be raised over a 3-year period, so that the numerous technical projects in the committee can be adequately financed. Specific funds are to be allocated for definite research projects now getting under way. A considerable amount of other work in the committee is to be carried out on a co-operative basis which will not involve any financial outlays directly.

Recognizing that additional test methods and recommended practices will be forthcoming from time to time, the

committee is organizing a new Panel (the committee's work is broken down into Panels on Steam Power, Gas Turbines, Aviation, etc.), to be responsible for proposed standards that may be developed. At the present time there are two recommended practices covering long-time and short-time creep tests (E 21 and E 22). A new Recommended Practice for Conducting Time for Rupture Tension Tests (E 85) has just been approved by A.S.T.M.

Certain problems involved in getting under way the Research Project 18 on Effect of Variables on Creep Properties of Steel have been overcome, and Battelle Memorial Institute, where the work is being done, expects that in about two to three months definite results will be available. The other sponsored research, also at Battelle, covering stability of steel as affected by temperature, is the subject of an extensive report which is to be presented at the December meeting of the A.S.M.E. This report is available in manuscript form. Specifically it covers the work on the role of aluminum in graphitization of carbon steels which has been studied through carbide extraction work. This work is to continue, and additional funds have been allocated.

In the Aviation Panel, test materials are being collected for its research on sheet materials, specifically to cover the statistical evaluation of creep-rupture properties of five selected alloys, studying ten lots of each alloy. Another very important subject, the effect of notch concentration on high-temperature properties, as related to fatigue, is to be studied in a research program. Among the several co-operative or round-robin projects in the Petroleum and Chemical Panel is one to determine the spread in properties of heats of carbon steel at temperatures of 800 to 1050 F. This involves material covered by A.S.T.M. Plate Specifications A 212.

Elsewhere in this BULLETIN reference is made to the important survey being started on high-temperature properties of certain austenitic steels and other alloys. Data sheets and return forms are being distributed to leading organizations. The objective is to make available reliable data badly needed by many groups such as the Boiler Code Committee, the group concerned with the code for pressure piping, and others, to set reasonable stresses and properties. The Data Panel responsible is taking the job in small bites and plans to expedite publication of the results promptly without waiting for the entire broad field to be covered.

The Joint Committee is continuing its stimulation of papers and symposiums to make available latest information on problems involving high and low temperature on which it has such a commendable past record, and at the A.S.M.E. Annual Meeting in December the Committee plans to have presented various papers and reports.

"C" Group

Committee C-1 on Cement

Plans for a symposium on flame photometry were announced to be jointly sponsored by Committees C-1 and D-2 at the 1951 Annual Meeting. A number of the working subcommittees reported continuation of investigations and round robin tests including lean mortar bar tests on sulfate resistance in which 16 U. S. and one Canadian laboratory are participating and a second series of tests on neat pastes for measuring time of set. Interesting discussion took place in the respective subcommittee on proposed specifications for blended portland fly ash cement and for fly ash to be used as a pozzolan with portland cement. These proposed specifications will be revised and copies made available to 12 fly ash producers who will conduct tests in order that the committee may evaluate the data before adoption of such specifications. These proposed specifications are essentially the same as those developed by the Bureau of Reclamation.

As a result of subcommittee discussion and recommendation, a change was included in the new tentative method of test for determining the bleeding of cement pastes and mortars recommended in the 1950 Annual Report. This change pertains to Section 7 (b) on mortars providing more definite procedure in the placing of the mortars in layers with specified tamping. Permission was obtained from the Executive Committee of the Board of Directors to include in the 1950 Annual Report a recommendation for immediate revision of the Standard Specifications for Portland Cement (C 150) which will clarify Footnote C to Table II.

Committee C-2 on Magnesium Oxychloride Cements

The Committee reviewed a group of test methods which had been referred back to the committee by the Administrative Committee on Standards and recommended resubmission of a total of 14 proposed tentative methods for determining pertinent physical properties of magnesium oxychloride cement compositions, sampling procedure, and chemical analysis of the component materials.

Committee C-3 on Chemical-Resistant Mortars

The Committee received reports from its subcommittees which denoted much progress in the development of tentative specifications covering the several types of chemical-resistant mortars under study. Two separate specifications are being prepared to cover silicate mortars, one for slow setting and the other for rapid setting types of cements. A final draft was reviewed covering sulfur mortars, but further consideration must be given to the development of tests for measuring chemical

resistance and shear strength. Revisions were discussed and accepted on a proposed tentative specification for resin cement mortars. The subcommittee on hydraulic mortars plans to write a method on chemical resistance with other properties considered as being covered by existing A.S.T.M. standards. Definitions have been agreed upon to define working and setting time and methods for measuring these properties are now being reviewed by the subcommittee. In the development of a test method for bond strength, the subcommittee has discussed existing test methods and will conduct tests using sandwich type specimens. It was suggested that the committee consider the field of tank linings as included within its scope. A new subcommittee was authorized to study chemical resistance.

Committee C-4 on Clay Pipe

The Committee has taken action to refer a new tentative specification for ceramic glazed pipe to letter ballot of the committee. Minor revisions in the Tentative Specifications for Standard Strength Clay Sewer Pipe (C 13T) and for Extra Strength Clay Pipe (C 200T) have been agreed upon in the committee subject to letter ballot. However, further study will be given to more extensive revision of Specifications C 200T. A task group was authorized for a complete review of the Recommended Practice for Laying Sewer Pipe (C 12). A comprehensive report was presented by the subcommittee on flue linings which is a new field of coverage by the committee. This report outlined the many difficulties encountered in setting up proper specifications such as providing conformance with both modular and old sizes of brick, the wide variety of requirements in various cities and changes taking place from the use of solid fuels. The subcommittee requested another year for the completion of studies being made. L. J. Blackmer was given official recognition for his 40 years of membership on the committee.

Committee C-7 on Lime

After recommending to the Society the acceptance of two new tentative specifications on hydrated lime for grease manufacture and on quicklime for calcium carbide manufacture, respectively, the Committee has authorized the subcommittee on chemical lime to secure comments on a proposed specification for lime for the leather treating industry. Work is continuing through cooperative tests with Committee C-14 on Glass on the determination of iron in lime. The research subcommittee is continuing its study of establishing an autoclave test in its research on popping and pitting. Changes are being considered in the Specification for Hydraulic Hydrated Lime for Structural Purposes (C 141). Following a review of the letter ballot on acceptance of a definition for agricultural liming materials containing four negative votes, the committee authorized the reference of this term back to the subcommittee on nomenclature for further study. The re-

sults of a questionnaire among the committee members requesting opinion on the need for specifications for agricultural liming materials indicated quite clearly that a majority of the committee was not in favor of such specifications.

Committee C-9 on Concrete

Committee C-9 on Concrete and Concrete Aggregates held meetings of many of its subcommittees followed by the main committee meeting on June 28. A few brief notes on activities reported by subcommittees show among other items that in the work on the evaluation of data a considerable collection is being made to show variations in test data. The usual interesting session conducted by the subcommittee on chemical reaction of aggregates in concrete held jointly with the respective subcommittee of Committee C-1 attracted many visitors with interesting discussion by various members on experience in testing reactive aggregates. W. Lerch, Portland Cement Association, displayed an osmotic cell used in this research work. It is planned to prepare an extensive description of rocks which will be published as information only which later may be proposed as an A.S.T.M. tentative. The present Specification on Lightweight Aggregate (C 130) received much needed attention at the meeting of the subcommittee for its revision and a meeting of a special task group has been set for September in order that a draft of a complete revision may be presented to the main committee for acceptance in October. It is expected that the revised specification will classify lightweight aggregates into types according to weight. It was announced that the next meeting of the committee will be held in conjunction with Committee C-1 as guests of the P.C.A. at their new laboratories.

Committee C-15 on Manufacturing Masonry Units

Possible revisions in the A.S.T.M. standards pertaining to concrete masonry units in respect to the moisture content requirement were discussed. Comments from members will be solicited on these revisions. A difference of opinion was indicated in respect to a proposed inclusion of grade AA classification in the Specification for Hollow Load Bearing Concrete Masonry Units (C 90) with a strength requirement of 1500 psi. Further study will be given to this proposed revision. Minor revisions and editorial changes were proposed and accepted for Specifications for Glazed Masonry Units (C 126T). Tentative revisions were also recommended for specifications covering structural clay floor tile and facing tile, C 57 and C 212T, respectively. A proposed tentative specification for chemical-resistant masonry units was reviewed and recommended for circulation to the entire committee for comments with subsequent letter ballot for approval. Final completion of this specification has been delayed due to the difficulty in preparation of a test method on solubility in sulfuric acid. One of the

oldest A.S.T.M. standards, Specifications for Drain Tile (C 4 - 24), has now been completely reviewed and rewritten and this revision will be recommended for approval by the Society as a tentative specification replacing the old standard.

"D" Group

Committee D-1 on Paint

Meetings of 77 subcommittees and sections of Committee D-1 on Paint and Paint Materials held over a three-day period is an indication of the active work under way. Committee D-1 has the distinction of holding the largest number of subcommittee meetings of any technical committee during this Annual Meeting.

At a technical session following the main D-1 meeting, the following two papers were presented:

"Adhesion Studies," A. M. Malloy, U. S. Navy, Bureau of Aeronautics.
"Film Thickness Measurements," E. J. Dunn, Jr., National Lead Co.

Cooperation with the F.P.V.P.C. is continuing through the Joint A.S.T.M.-Federation Committee. The joint committee recommended to the D-1 Advisory Committee that specifications be prepared on glycerin for varnish and resin-making purposes.

An important accomplishment was the completion of two new record forms for reporting results of exposure tests of organic coatings. These cover a single panel record form and a multi-panel inspection sheet. Both forms are to be published later in the summer under the joint jurisdiction of the A.S.T.M. and the Federation of Paint and Varnish Production Clubs. (F.P.V.P.C.).

In its report to the Society, Committee D-1 presented seven new methods of test covering, respectively, heptane number of hydrocarbon solvents, Kauri-butanol value of hydrocarbon solvents, nitrocellulose diluting power of hydrocarbon solvents, chemical analysis of blue pigments, chemical analysis of chromium pigments (to replace Standard D 126), chemical analysis of zinc dust (to replace D 521), and tests for elasticity or toughness and drying time of varnishes.

The Subcommittee on Bituminous Emulsions presented for D-1 letter ballot new Proposed Performance Specifications for Asphalt Base Emulsions for Use as Protective Coatings for Metals. The test methods needed in connection with these performance specifications are now covered by the Tentative Methods of Testing Bituminous Emulsions for Use as Protective Coatings for Metal (D 1010 - 49 T).

The Subcommittee on Traffic Paint reported completion of three new test methods for (1) roundness determination of glass spheres or percentage true spheres, (2) crush resistance of glass spheres, and (3) dry to no-dirt pick up. At the meeting of the subcommittee promising results were

reported on transmission measurements on glass beads and on accelerated suspension tests. Plans have been made for cooperative tests to develop a suitable accelerated test for the durability of traffic paint.

The Subcommittee on Accelerated Tests submitted an important revision in the Tentative Method for Immersion Testing of Paint Coatings on Steel Surfaces (D 870) in which the test liquid will be limited to distilled water. The revised method will require the test liquid to be changed at least every 72 hr. to avoid contamination, or more often if visible rust or other manifest change appears in the liquid. If successive tests are to be correlated, reference panels coated with a control paint must be used.

Action was taken to proceed with a complete revision of the Methods of Analysis of Titanium Pigments. A new project was initiated to study the effect of surface-treating agents on pigments in respect to analytical procedures.

The Subcommittee on Varnishes is actively studying the matter of tests for color. These cooperative tests will include a study of samples of various clear vehicles which would represent not only the majority of colors encountered by the coatings industry but also important minor deviations from the color range covered by the Gardner 1933 Standards. Study is being made of a rapid method for determination of nonvolatile content of varnishes. The Subgroup on Viscosity has completed its work on the bubble tube method and recommended numerical results, upon which its proposed method is based, for publication in an early issue of the ASTM BULLETIN. This paper will supplement the earlier one on "Viscosity Measurement," by M. R. Euverard, to be published in the September issue of the ASTM BULLETIN. Consideration is now being given to a method using the Ford efflux viscosity cup based on the recommendation of the Chicago Paint and Varnish Production Club. Other suggestions being studied include phthalic anhydride analysis, alkali resistance, exterior durability, and air resistance on varnishes.

The Subcommittee on Optical Properties has under way a cooperative study in 20 laboratories of small color-difference measurements of a series of gray panels. A revised method for determining hiding power is under review. A proposed 20-deg. specular gloss test for high-gloss specimens is being studied. A test procedure for sheen, which is a specular gloss method for low-gloss specimens, is also being studied.

The Subcommittee on Resins has completed a new method for determining total chlorine in resins used for surface coatings. A test for softening point of resins has also been completed and is being discussed with representatives of other Society committees looking toward the adoption of a single method. Round-robin tests are in progress on the following: precipitation method for total solids, foil method for total solids, solvent tolerance for amino resins, viscosities of resin solutions, and Swann method of determination of phthalic

anhydride in the presence of other dicarboxylic acids.

The new Subcommittee on Electrometric Testing of Paint Films has obtained considerable data from cooperative time-potential tests. These data are now being subjected to a statistical analysis prior to undertaking further work.

The Subcommittee on Physical Properties has been especially active. It presented a revision of the methods for producing films of uniform thickness of paint, varnish, lacquer, and related products on test panels (D 823) which provides a new Procedure D for applying uniform films by a motor-driven blade film applicator. This subcommittee also presented a new tentative method for measurement of dry film thickness of nonmagnetic coatings of paint, varnish, lacquer, and related products applied on a magnetic base. This method will supplement the present thickness test D 1005. Progress reports were presented on the following subjects under study in the subcommittee: oil absorption of pigments, consistency of pastes, adhesion, and permeability of paint films.

A new proposed tentative method of test for cold-check resistance of clear nitrocellulose lacquer films applied to wood was presented by the Subcommittee on Cellulose and Related Products. This method of test describes a procedure for determining the resistance to checking or cracking of clear nitrocellulose lacquer films applied to wood or plywood substrate when subjected to sudden changes from warm to cold temperatures.

Committee D-2 on Petroleum

For the third year in succession Committee D-2 on Petroleum Products and Lubricants had the distinction of presenting to the Society the largest report both as to size (94 pages) and the number of recommendations. The committee added to its report for publication as information a definition for tractor fuel and specifications for a light grade and a regular grade farm tractor fuel prepared by Technical Committee L. The recommendation for adoption as standard of the tentative method of test for foaming characteristics of crankcase oils (D 892 - 46 T) was withdrawn from the report by the committee.

There were a total of 66 meetings of Committee D-2 and its various technical committees and research divisions held over the full five days of the Annual Meeting.

Committee D-2 announced that its Fall Meeting will be held in Detroit, at the Book-Cadillac Hotel, on October 8 to 11.

At its Annual Dinner on Tuesday evening, Committee D-2 honored A. E. Miller and C. A. Neusbaum for their many contributions to the work of the committee. Each of the recipients was presented with an appropriately worded scroll in commemoration of this tribute from the committee. Dr. T. G. Delbridge served as toastmaster at the dinner.

At its February, 1951, meeting the committee will sponsor a second symposium

on high-additive content oils. Copies of the first symposium on this subject, held in San Francisco in October, 1949, are now available as special Technical Publication No. 102.

During the meeting Committee D-2 furthered plans for three symposiums which it wishes to sponsor at the Annual Meeting of the Society in June, 1951. The first of these is a symposium on flame photometry under the joint sponsorship of Committee D-2 and Committee C-1 on Cement. The second symposium is on lubrication under extreme pressure conditions sponsored by Technical Committee B on Lubricating Oil. The third symposium on fretting corrosion is being sponsored by Technical Committee G on Grease with the cooperation of Technical Committee B.

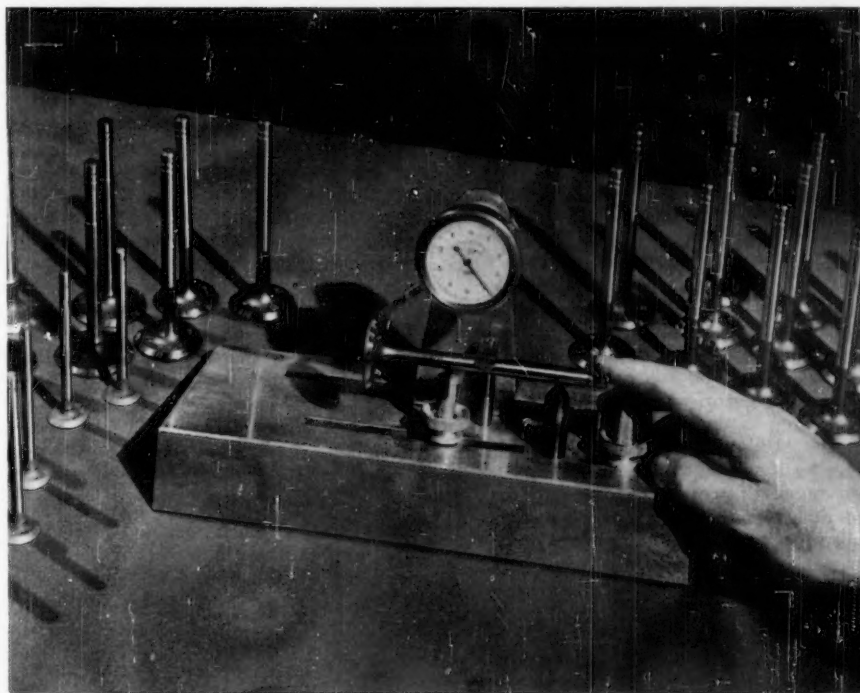
The committee reported acceptance by the Administrative Committee on Standards of four new tentative methods and revision of an existing tentative which are to be published in the new A.S.T.M. Manual on Measuring and Sampling Petroleum and Its Products. The Manual is expected to be available early in September.

Committee D-2 presented to the Society for publication a set of three tables listing the physical constants of hydrocarbons boiling below 350 F. The tables will present in concise form fundamental data for the following six classes of hydrocarbons: paraffins, mono-olefins, diolefins, acetylenes, naphthenes, and aromatics. With each of the three tables there will be included a complete bibliography. The physical constants compiled in these tables represent what the committee believes to be the best values appearing in the literature up to May, 1950. The committee plans to keep the information and data up to date by issuing new and revised tables periodically.

Active work is under way on a complete revision of the D-2 publication on Significance of Test of Petroleum Products. The material is now about 75 per cent completed but before publication the revised statements will be reviewed by the various D-2 technical committees and research divisions. It is hoped that the new publication will be ready by the fall of 1951.

The new Technical Committee M on Petroleum Waxes functions as a joint committee of A.S.T.M. and the Technical Association of the Pulp and Paper Industry. Eight working sections have been organized and are proceeding with the development of test programs. The next meeting of this technical committee will be held in Rochester on September 13 to 15, in connection with the second TAPPI testing conference.

With its report the committee included eight methods for publication as information. These covered tests for hydrocarbon analysis of Diesel fuels by silica gel adsorption, two methods for bromine number of petroleum distillates, test for refractive index of hydrocarbon liquids, density test of hydrocarbons by pycnometer, pour stability test for winter grade motor oils, and a test for reduced pressure distillation of petroleum products. Also



"Concentricity Check"

Second prize-winning photograph, General Section in the Seventh A.S.T.M. Photographic Exhibit, by J. Jean Vincent, Ethyl Corporation.

nine new methods were submitted to the Society as tentative. These covered apparent viscosity of greases, boiling range of butadiene, carbonyl content of butadiene, correction factors and tables for liquefied petroleum gases, test for phosphorus in lubricants, analysis of isooctane and normal heptane blends by infrared spectrophotometry, test for 1,3-butadiene in C₄ hydrocarbon mixtures by ultraviolet spectrophotometry, acidity of residue from gasoline, and water tolerance of aircraft fuels.

An important revision in the tentative specifications for gasoline (D 439 - 49 T) provides for an increase in the vapor pressure.

A revised specification for diesel fuel oils (D 975) was accepted and a number of changes were made in the specifications for aviation gasolines (D 910) involving the separation from the specifications of certain test methods and the establishment of these as separate methods with appropriate references included in the specifications. Consideration is being given to two additional grades, 80/—, and 108/135, of aviation gasoline for inclusion in Specifications D 910.

There was considerable interest expressed in a proposed classification of industrial gear oils considered at a meeting of the section on this subject. It was decided to obtain by means of a questionnaire more complete information regarding such a proposed classification from a number of companies, organizations, and individuals interested in this subject.

Committee D-3 on Gaseous Fuels

In its annual report to the Society,

Committee D-3 on Gaseous Fuels announced that it had approved by letter ballot, a new proposed Tentative Method of Test for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature. This method will be presented to the Society during the summer through the Administrative Committee on Standards for acceptance as tentative.

Three other methods have been completed and are now the subject of letter ballot vote in the committee. The first of these will provide detailed procedures for sampling natural gases. The other two methods cover procedures for the analysis of gaseous fuels. Of these two companion methods, one covers the analysis of natural gases by the volumetric-chemical procedure, and the other analysis of natural gases and related types of gaseous mixtures by the mass spectrometer. The volumetric-chemical method is intended for use when complete composition of the gas is not required, while by the mass spectrometer method the complete chemical composition can be obtained.

These four new methods together with the three methods already completed by Committee D-3, make a representative group of standard procedures for the testing and evaluation of gaseous fuels. The three existing methods which cover tests for a calorific value (D 900), specific gravity (D 1070), and methods for measurement of gaseous fuels (D 1071) were issued in December, 1949, in a special Society publication sponsored by Committee D-3. It is expected that a similar publication will be issued containing all seven methods.

Committee D-4 on Road and Paving Materials

Among the many subcommittee reports presented at the committee meeting were recommendations for acceptance of a proposed tentative method of test for the resistance to plastic flow of fine aggregate bituminous mixtures. This method is commonly known as the Hubbard-Field Stability Test. Cooperative tests are under way on five grades of samples to establish data on softening point of bituminous materials; data are being collected to check the viscosity method and its degree of reproducibility by series of cooperative tests on four materials at five different laboratories; additional study is to be given to the E gradings in the Los Angeles Abrasion Test (C 131); further check tests will be run to establish check data on setting qualities of bituminous materials to reduce discrepancies in previous tests, leading to the preparation of a test method; and cooperative tests will be made on pure viscosity of high viscosity emulsified asphalts.

The subcommittees working on specifications reported the following actions: a tentative revision of the Specification for Emulsified Asphalt (D 977); a proposed specification on portland-cement concrete bases and pavements is being prepared; specifications covering bituminous road mixtures and aggregates used therein (D 692, D 947, D 978, and D 1073) will be reviewed in the light of providing a soundness requirement for fine aggregate and an extraction test; major revisions are contemplated in the two standards on preformed expansion joint fillers (D 544 and D 545) in order to provide more adequate performance standards; as a result of comments received a proposed specification for hot-poured joint filler will be revised, and cooperative tests will be made to establish data for a proposed test method; and the joint D-4, D-18 subcommittee recommended a new method of test for the determination of chloride in soils to be submitted to letter ballot of the committee.

Committee D-5 on Coal and Coke

The outstanding item of interest in the report of Committee D-5 is a statement covering the activities of the Section on Sampling for Large Users of Coal of Subcommittee XIII on Coal Sampling. This section, newly constituted under the chairmanship of R. P. Liversidge of the Philadelphia Electric Co., is concerned principally with the automatic sampling of crushed or nut-slack coal in the course of producer or user handling. At the section's first meeting an exploratory test program was established which is designed to gain an idea of the comparability of results obtained with various users' sampling devices. The current work is the outgrowth of an interest developed by the Chemical Committee of the Edison Electric Institute which will cooperate with the A.S.T.M. in this study. This work should be of considerable interest to other committees interested in sampling granular materials.

Committee D-6 on Paper and Paper Products

Items of interest reported, in addition to that found in the Annual Report of the committee, included announcement that the subcommittee on specifications will investigate materials to be covered by a specification for paper for multi-walled shipping bags. Round-robin testing is in progress on several new testing procedures by the subcommittee on container board including the ring crush, tensile strength, and puncture tests. The revision of the Monograph on Paper and Paperboard, Characteristics, Nomenclature, and Significance of Tests is expected to be completed early in 1951.

Committee D-8 on Bituminous Waterproofing and Roofing Materials

Committee D-8 received reports from subcommittees which included action as noted in the following items. A proposed specification and method of test for insulating siding material is still under consideration by the respective subcommittee and is expected to be presented at the spring meeting of the committee. Further study is to be made on a cooperative basis with the Insulating Siding Assn. The study of the properties of roofing nails, such as nail holding necessary for satisfactory application, is being continued. This study also includes a comparison of steel versus aluminum nails. Work is under way in the subcommittee on membrane and built-up roofing on perforated felt for use in the elimination of entrapped air between layers. Consideration will be given to the arrangement, diameter of opening, and number of perforations per square foot. Three task groups have been designated to develop and try out proposed specifications on three types of bituminous cut-back coatings for cold application which will include possible consistency ranges. A questionnaire will be submitted to members of the subcommittee on ductility tests to solicit comments and statements on the significance of this test. The subcommittee on accelerated tests has now standardized on an instrument for end point determination and its calibration, leading toward a development of a tentative method of test. Agreement has been reached upon a uniform preparation of specimens for testing. A proposed method of determining preferential wetting of roofing granules with asphalt was reported in process of development. A cigarette paper-stain test and a fine powder stain test are under consideration.

Committee D-9 on Electrical Insulating Materials

Committee D-9 together with 20 of its subcommittees held meetings at which further progress was made on a number of projects under study.

Committee D-9 joined with Committee D-20 in withdrawing from its report the proposed tentative specifications for cellulose acetate sheet and film for electrical insulation.

The revised methods of testing electrical

insulating oils submitted as tentative represent the results of several years work by the committee in preparing definitions and statements regarding the significance of the various test methods covered. Also included were revised methods of testing glass-bonded mica used as electrical insulation which is an improvement over the original methods published last year.

The changes in the tentative methods of testing untreated paper used in electrical insulation (D 202) provided for the addition of definitions and statements on significance of a number of the tests covered. Also added were new test procedures for determining heat stability, water-soluble matter, and alcohol-soluble matter, also references to procedures for fiber analysis and for water-soluble sulfates.

The Subcommittee on Insulating Varnishes has under way a complete revision of the present methods D 115 in order to make them more useful for classification and control purposes. Consideration is being given to the preparation of methods for the following five classes of electrical insulating varnishes: spirit soluble, oxidizing air drying, thermosetting, oxidizing, and asphaltic. Work is under way on specifications for silicone varnishes based upon the present Navy Department specification. New sections have been established to study tests for solid content and heat flexibility of insulating varnishes. The committee is arranging to coordinate its work with the work of Committee D-1 as regards standards for varnishes.

The specifications for laminated thermosetting materials (D 709) are under study with the objective of bringing about a general agreement with the new military specifications for laminated products and similar NEMA standards.

The Subcommittee on Solid Filling and Treating Compounds has now completed test methods for cold flow point of waxes and for drip temperature of dipping waxes. Also procedures for determining volume expansion and contraction. Studies are continuing on the brittleness test. The work of this committee is being coordinated closely with that of the new Joint A.S.T.M.-TAPPI Committee on Petroleum Wax organized under Committee D-2 as mentioned earlier in this BULLETIN.

Further progress has been made in studies of revisions in the several general electrical test methods. In particular the methods of test for power factor and dielectric constant of electrical insulating materials (D 150) will be quite extensively revised.

Committee D-11 on Rubber

Committee D-11 and its subcommittees held a total of some 20 meetings over a period of three days.

Committee D-11 will act as host during a meeting of Technical Committee 45 on Rubber of the International Organization for Standardization which will be held in Akron, Ohio, from October 16 to 20. A rather complete agenda has been prepared for this meeting which will be held at the Hotel Mayflower in Akron.

An organization meeting of the new Subcommittee on Crude Natural Rubber was held in Detroit on April 19. Task groups have been appointed to develop methods for the quantitative determination of foreign material such as dirt, sand, bark, etc., in crude rubber. Another task group will give consideration to compounding formulas for natural rubber to determine the best recipe for evaluation. The subcommittee will hold a meeting in Akron at the time of the ISO session in October, since the work being undertaken by this subcommittee has considerable international interest.

Plans were made for the development of a series of statements covering the significance of the various tests applied to rubber and rubber products. The D-11 Advisory Committee will serve as a planning committee in initiating the preparation of this material which should be a very valuable publication when completed.

All of the recommendations on standards in the preprinted report were accepted and the committee announced that several recently completed methods and specifications as noted below would be presented to the Society through the Standards Committee subsequent to the Annual Meeting. One of the most important items included in the report was the extensively revised tentative methods of chemical analysis of rubber products. These revised methods are in general agreement with corresponding procedures of the Federal Specifications Board. They include the most up-to-date directions for the analysis of rubber products and should find wide acceptance in the industry.

A complete set of revised and up-to-date methods for the testing of flat rubber belt to replace the present Methods D 380 were accepted for committee letter ballot and submission as tentative to the Society.

The committee also received a new proposed tentative method of test for the accelerated ozone cracking of vulcanized rubber. This method is intended for use in estimating relative resistance of such materials to cracking when exposed, under tension, to air containing a definite low concentration of ozone. While the procedure is based largely on the work of Crabtree and Kemp as reported in *Industrial and Engineering Chemistry*, in December, 1946, it was completed after a series of round-robin tests to determine reproducibility and in particular the degree of uniformity obtained by individual laboratories in maintaining specified ozone concentration.

The S.A.E.-A.S.T.M. Technical Committee on Automotive Rubber submitted several recommendations for committee approval, including an extensive revision of the present tentative specifications for rubber and synthetic rubber compounds for automotive and aeronautical applications (D 735), also important changes in the tentative methods of test for contact and migration stain of vulcanized rubber in contact with organic finishes (D 925). The latter will include use of both the RS and S-1 Lamps. Work is being com-

pleted on a new method of test for heat and light discoloration of vulcanized rubber and organic finish coated compounds. A number of new projects are under study in the technical committee including standards for evaluating color, color pattern, and color matching, abrasion testing, static exposure testing, low-temperature testing, and consideration of silicon rubbers. A revision of the present tentative specifications for natural rubber cups for use in hydraulic actuating cylinders (D 818) and new specifications for heavy-duty hydraulic brake cups are expected to be completed in the fall. At the September meeting of the technical committee it is also expected that action will be taken on a comprehensive specification for gasket materials for general automotive and aeronautical purposes. These specifications will cover gaskets of the following types: rubber or synthetic rubber or compositions of both, cork compositions, paper and fiberboard, and asbestos fiber.

The Subcommittee on Rubber Thread reported that further round-robin tests are being made on specific gravity and on measurement of stress-strain properties under fixed load. The first set of methods for testing rubber thread are now published as information in the new edition of the special Compilation of A.S.T.M. Standards on Rubber Products, copies of which are now available.

The Subcommittee on Protective Equipment for Electrical Workers which also functions as A.S.A. Sectional Committee J6 announced that it had under study specifications for rubber gloves which will replace Standard D 120. Extensive round-robin tests on thickness measurement are now in progress in order to establish thickness limits for the proposed three classes or levels for proof test voltages.

The Subcommittee on Packings is continuing its study of a relaxation test for pure vulcanized compounds. It has obtained data on 1½ by ¾-in. pellets of two 33R9 compositions at 70 and 100 C. obtained on the following machines: Beam machines of Goodrich and General Motors, Mare Island compressor, Goodrich pneumatic machine, and the SR-4 Strain Gage.

Plans were announced for active work by the Subcommittee on Hard Rubber in the development of a series of eight new test procedures for asphalt composition battery containers, and a revision of the bulge test now in Method D 639.

The Subcommittee on Insulated Wire and Cable reported that specifications are in preparation for polyethylene insulated power cables and for butyl rubber insulation.

Committee D-13 on Textile Materials

Committee D-13 on Textile Materials presented to the Society a comprehensive report (73 pages) containing many recommendations affecting standards. Based on some comments and objections received in the committee letter ballot the proposed revision of the Tentative Method of Test for Resistance of Textile Materials to

Microorganisms (D 684) was withdrawn from the report by the committee. This change required retaining as tentative the present tentative Method D 862 which had been recommended for withdrawal in the report as preprinted.

One of the most important methods presented this year by Committee D-13 covered a set of test procedures for determining the resistance of textile fabrics to water. They are applicable to all fabrics both treated and untreated regardless of fiber composition. These methods were developed in cooperation with the American Association of Textile Chemists and Colorists. Also included in the report were the first set of methods for testing bonded fabrics which materials are neither woven, knitted, nor spun but are built up by the interlocking of fibers by chemical bonding material, by chemical work, chemical action, moisture, and heat.

A new test for determining the snag resistance of women's Nylon hosiery is a companion method to the stretch test submitted last year. Other new methods covered a procedure for determining vegetable matter in scoured wool, specifications for mechanical sheet felt, and a new test for resistance of carpets to insect pest damage. Further changes were made this year in the methods of test for fineness of wool and for fineness of wool tops.

Committee D-15 on Engine Antifreezes

Although Committee D-15 has been organized only three years, it presented to the Society this year five new tentative methods and one specification. The test methods cover the following procedures used in testing and evaluating engine antifreezes: reserve alkalinity, specific gravity, determination of water, boiling point, and ash content. The specification covered detailed dimensional and constructional requirements for a hydrometer-thermometer field tester. This tester will be used in connection with a new method of test for freezing point which the committee hopes to present to the Society later in the year. Information and test data obtained in the study of the freezing point method were presented in the form of a technical paper by R. E. Mallonee and F. L. Howard, on "The Determination of Freezing Protection of Engine Antifreezes." In its report the committee included supporting data obtained in cooperative tests carried on in the development of the several methods.

It was announced that the next meeting of the committee would be held in New York City in September. At this meeting reports will be received on the status of other test methods under development and particularly on the investigation of simulated and actual service testing. It is hoped that this latter study will result in a laboratory test procedure that will consistently distinguish between safe and deleterious antifreeze products. Methods of sampling antifreeze also are being prepared.

Committee D-16 on Industrial Aromatic Hydrocarbons

The changes recommended by Committee D-16 in the distillation test and in a number of specifications for industrial aromatic hydrocarbons was in the interest of coordinating these standards with similar A.S.T.M. standards. The principal change in the distillation test involved the use of the condenser now specified Method D 86, while retaining the present condenser as an alternative. In similar manner, the revisions in the specifications involved the use of the existing A.S.T.M. solvent distillation thermometers with the thermometer specified in Method D 850 as alternative.

Committee D-16 has under consideration an extension of its scope in view of the fact that there are related chemicals other than hydrocarbons that are of industrial importance. It is hoped that some decision may be reached on this matter during the coming year.

Committee D-17 on Naval Stores

Committee D-17 on Naval Stores withdrew from its report two recommendations for adoption as standard with revisions of the Tentative Method of Test for Saponification Number of Rosin (D 464) and the tentative methods of test for acid number of rosin (D 465). All the other recommendations in the report were accepted, including the methods of test for rosin oil. The proposed alternate method of test for unsaponifiable matter in rosin was accepted for publication as information. The committee plans to study further the tests for acid number and saponification number.

Committee D-18 on Soils

Plans were announced at the meeting of Committee D-18 on Soils for Engineering Purposes for symposiums to be presented at the 1951 Annual Meeting on surface and subsurface exploration and on consolidation. Three sampling methods being studied by the subcommittee on soil investigation include a method for split spoon sampling, Shelby tube (thin wall tube) sampling and sampling of embankment materials to include method on borings. Revisions are to be considered in the methods of tests for the mechanical analysis of soils (D 422) which will include changes in grain size and silt size. The desirability of a direct shear test was discussed including type of equipment. A proposed method of determining the chloride content in soils was recommended for approval by the committee. Three suggested procedures for soil bearing tests covering flexible or nonrigid type pavements and static load tests are being rewritten, with changes incorporated, for consideration of the subcommittee.

Committee D-19 on Industrial Water

On the recommendation of committee D-19 four new methods were accepted:

determination of sodium and potassium, electrical conductivity, and hardness in industrial water, and identification of types of microorganisms in water. The Tentative Method of Test for Total Aluminum and Aluminum Ion in Industrial Water (D 857) was recommended for advancement to standard. Revisions for immediate adoption were recommended in the Standard Method of Reporting Results of Chemical Analysis of Water-Formed Deposits (D 933) to cover the reporting of results of X-ray diffraction and petrographic examination and results of spectrochemical analysis.

The committee recommended for immediate adoption a new standard on Definitions of Terms Relating to Industrial Water, in which all the D-19 definitions formerly appearing in the various methods have been incorporated for greater convenience in use.

The recently formed Subcommittee on Water-Borne Industrial Wastes reported good progress in preparation of methods applicable to this special field in the activities of Committee D-19.

It is expected that during this summer, specifications for "substitute sea water" will be submitted for publication as tentative.

Committee D-20 on Plastics

At a two-day meeting of Committee D-20 on Plastics and its 11 subcommittees, progress was made on a number of matters under study in the committee. In cooperation with Committee D-9 the committee withdrew from its report the proposed tentative specifications for cellulose acetate sheet and film for electrical insulation. It also withdrew from the report the recommendations for adoption as standard of the tentative specifications for methacrylate molding compounds (D 788-48 T) and the tentative methods of test for weight loss of plastics on heating (D 948). All of the other recommendations in the report were accepted.

The new recommended practice for injection molding of specimens of thermoplastic materials is a valuable addition to the present molding procedures. Important changes in the general specifications for molds for molding test specimens include an alternate mold for injection molding and a new mold for injection molding of weld test specimens.

The extensive changes made in the method of test for luminous reflectance and transmission characteristics and color of plastics (D 791) are the result of an intensive study of this method by the committee for the past year. The revised method was adopted as standard and expectations are that it will be widely used. The revised specifications for melamine-formaldehyde molding compounds (D 704) were accepted with changes in the numbers of the types of molding compounds covered.

Jurisdiction for standards on vulcanized fiber has now been assigned jointly to Committees D-20 and D-9. Committee D-20 is also working jointly with Committees D-9 and D-11 on standards for

vinyl plastics and is cooperating with Committee D-1 in the consideration of plasticizers and resins. Cross representation between the several committees has been arranged on these subjects.

Committee D-20 has endorsed American participation in the activities of Technical Committee 61 on Plastics of the International Organization for Standardization and also favors acceptance by this country of the secretariat for this ISO project. It was recommended that the scope of the work be limited initially to the standardization of test methods and of terminology.

The general methods of conditioning plastics and electrical insulating materials for testing (D 618) are to be further revised during the coming year, one of the changes involving the inclusion of a new conditioning Procedure F at 96 ± 1 per cent relative humidity at a temperature of $23 \pm 1.1^\circ\text{C}$. ($73.4 \pm 2^\circ\text{F}$).

"E" Group

Committee E-1 on Methods of Testing

In its report to the Society Committee E-1 submitted a new tentative method of verification and classification of extensometers, a new butadiene boiling point range thermometer specification, and a complete revision of the specifications for the stability test of soluble nitrocellulose thermometer. The proposed revised tentative method of test for Brinell hardness of metallic materials was further modified by the committee. The revisions in the Methods of Verification of Testing Machines (E 4) and the verification of calibration devices for verifying testing machines (E 74) were accepted.

The following brief summary covers the matters considered at the meetings of 14 E-1 subcommittees and task groups. The Subcommittee on Rheological Properties reviewed a comprehensive summary describing various types of apparatus for determining absolute viscosity prepared by W. H. Markwood, Jr. It is planned to submit this collection of information for publication.

The Task Group on Softening Point hopes that it will be possible to reach agreement on the consolidated shouldered ring and ball method within the coming year. Results of the cooperative Saybolt furol viscosity test for asphaltic materials at high temperatures were reviewed.

The Subcommittee on Conditioning and Weathering furthered its plans for sponsoring a symposium at the 1951 Annual Meeting. Robert Burns has accepted the chairmanship of the symposium committee. It is felt that this is a very timely subject in view of the great activity in this field of endeavor since and during the war.

The Subcommittee on Hydrogen Ion Determinations is planning to develop colorimetric methods for pH determination, and in this connection it is planned to increase the personnel of the subcommittee by the addition of representatives of manufacturers of apparatus used in this test. The committee has received a request from Committee D-19 that a flow type electrode be included in the present tentative method for determination of the pH of aqueous solutions with the glass electrode (E 70).

The work of Subcommittee 15 on Chemical Analysis has been reactivated and plans were made at its meeting to review and coordinate the several existing methods of chemical analysis of nonmetallic materials. The personnel of this subcommittee has been enlarged to include representatives from all other technical committees of the Society interested in the analysis of nonmetals. This work will also be tied in closely with that of Committee E-3 on Chemical Analysis of Metals.

Subcommittee 21 on Metalware Laboratory Apparatus at a reorganization meeting under its new chairman, E. L. Ruh, gave consideration to the formulation of ways and means whereby this group might best aid and advise the technical committees of the Society in the development of laboratory metalware apparatus and in the elimination of inconsistent, conflicting, or obsolescent practices now troubling manufacturers and users.

Attendance was gratifying from a membership that is well balanced between manufacturers and representatives of the technical committees of the Society. In addition, the meeting was attended by several nonmembers invited because of their advisory capacity with other A.S.T.M. committees. These visitors contributed tangibly to the formulation of policy whereby Subcommittee 21 hopes sincerely to be of real service to the Society.

Following formulation of policy, preliminary steps were taken to cooperate with several A.S.T.M. Committees in the elimination of certain specifications which have contributed in the past to operating difficulties or to costly equipment.

It is urged that the members of all technical committees of the Society keep in mind that Subcommittee 21 of Committee E-1 stands ready to aid and advise on matters relating to laboratory metalware apparatus. This subcommittee would be most grateful if its services are solicited whenever it might be helpful.

Committee E-2 on Emission Spectroscopy

The major activity in Committee E-2 for some time has been the collection and review of a number of suggested methods of emission spectrochemical analysis. Approximately 50 such methods will be ready for publication as information by the end of 1950. Also ready for publication as information are a report on "Location, Installation, and Safety Precautions

for the Spectrographic Laboratory," a report on "Specification of Spark Generators," and a "Suggested Method for Photographic Processing."

Committee E-2 has cooperated in the work of the A.S.T.M.-S.A.S. Joint Committee on Nomenclature in Applied Spectroscopy and recommends publication, with the above suggested methods and reports, of the "Suggested Nomenclature in Applied Spectroscopy" that has been prepared by the Joint Committee.

Committee E-3 on Chemical Analysis of Metals

A major activity of the meetings of Committee E-3 and its subcommittees was the review of the material to be included in the 1950 Book of A.S.T.M. Methods for Chemical Analysis of Metals. The committee recommended that the following six new methods be submitted to the Administrative Committee on Standards for publication as tentative: chemical analysis of nickel-copper alloys; sulfur in special brasses; chemical analysis of antimony; photometric methods for chemical analysis of lead, tin, antimony, and their alloys; aluminum in zinc-base die-casting alloys; and sampling non-ferrous metals and alloys in cast form for determination of chemical composition.

Also approved for submittal to the Administrative Committee on Standards were revisions in seven tentatives to be continued as tentative, and the revision and reversion to tentative of three standards.

Revisions for immediate adoption in the Recommended Practices for Apparatus and Reagents for Chemical Analysis of Metals (E 50 - 48) were submitted to the Society. Of particular importance is the complete revision of the section in E 50 covering hazards in the use of certain reagents.

Committee E-3 has long recognized the need for information on the precision and accuracy of the methods prepared by the committee. Action was taken to set up the initial steps in a program for the systematic collection of data for the evaluation of the precision and accuracy of E-3 methods.

Committee E-4 on Metallography

During the past several years Committee E-4 has been very active in developing grain size standards for various metal products. In 1949 the Society approved for publication Tentative Methods E 79 for Estimating the Average Grain Size of Wrought Copper and Copper-Base Alloys. Now approved by letter ballot of Committee E-4 and ready for submittal to the Administrative Committee on Standards for Society approval is the new Proposed Tentative Methods for Classification of Ferrite Grain Size in Steels. Another new method covering the estimation of the average grain size of non-ferrous metals (other than copper and its alloys) is in its final stages for letter ballot of Committee E-4.

In 1949 a new Subcommittee XI on Electron Microstructure of Steel was established. This group of men had been working for a number of years as the Joint Committee on Electron Microstructure of Steel. The first Progress Report of this group appeared as an Appendix to the Report of Committee E-4. This progress report comprises 49 pages, including 47 reproductions of light and electron micrographs of several microstructural constituents of a eutectoid steel. The main purpose of the report is to present techniques for obtaining electron micrographs which would be directly comparable to those obtained by the optical method.

Committee E-7 on Non Destructive Testing

In addition to sponsoring the symposium on the Role of Nondestructive Testing in the Economics of Production during the Annual Meeting of the Society, Committee E-7 also has under way in its subcommittee structures quite a range of standardization work. A Proposed Tentative Recommended Practice for Radiographic Testing has been developed for distribution to the members of Committee E-7 as well as to other interested parties for the purpose of obtaining criticism. It is expected that copies of this recommended practice in duplicated form will be available from A.S.T.M. Headquarters on request.

The work on preparation of radiographic standards for steel welds has progressed rapidly and a definite proposal will soon be ready for the consideration of the committee. A proposed method for magnetic particle testing of steel castings is in a preliminary form. This document is intended to apply to large steel castings over 20 in. in any dimension and it is proposed to include a set of specific recommended procedures including prod spacings and definite amperage requirements.

Committee E-9 on Fatigue

Committee E-9 reported that since the last meeting the Manual on Fatigue Testing was published. This book will be helpful to those setting up facilities for fatigue testing and to those responsible for the reporting of such tests. The committee also provided for a number of papers at this Annual Meeting.

The Survey Subcommittee has been working (1) to prepare a list of all fatigue projects that are now in progress in the principal laboratories of the United States and Canada and (2) to compile a list of fatigue topics on which further information is desired. A general questionnaire was sent out in January and 64 laboratories have furnished information on at least one current project. The report of the Survey Subcommittee is appended to the report of Committee E-9.

Committee E-11 on Quality Control of Materials

Committee E-11 presented to the Society the first three sections of a new A.S.T.M. Manual on Quality Control of Materials which represents a revision and replacement of the present A.S.T.M. Manual on Presentation of Data including Supplements A and B. The first section represents a relatively minor revision of the main section of the present A.S.T.M. Manual and includes a discussion of the application of statistical methods to the problem of condensation of information contained in a single set of n observations. Section 2 is a moderate revision of Supplement A of the present manual, but it covers the problem of presenting limits to indicate the uncertainty of the average, \bar{X} , of a unique sample of n observations and suggests a form of presentation for use in A.S.T.M. reports and publications. Section 3 on the control chart method of analysis is an extensive revision of Supplement B. In general the technical content of the present Manual is retained but important additions and modifications are introduced. The new Manual on Quality Control is expected to be available by September.

Committee E-11 has several task groups actively at work on the following subjects: (a) survey of A.S.T.M. sampling plans, (b) recommended practices for planning interlaboratory tests, (c) procedures for determining number of tests for a desired precision of an average, (d) sampling of bulk materials, (e) fitting of curves for a linear relationship, and (f) consideration of definitions and nomenclature for such terms as "precision," "accuracy," "reproducibility," "reliability," and allied terms. Plans are under consideration for the sponsoring of a symposium on sampling of bulk materials to be held at the 1951 Annual Meeting of the Society.

Paint Federation Approves 31 A.S.T.M. Standards

The Federation of Paint and Varnish Production Clubs has approved 31 A.S.T.M. Standards—12 specifications and 19 methods of test. In addition the Federation has adopted two methods which are under consideration for acceptance as A.S.T.M. standards. The titles and designations of these 33 standards are as follows:

Title and Designation	
F.P.V.P.C.	A.S.T.M.
1-32	Method of Test for Tinting Strength of White Pigments (D 332 - 36).
2-32	Method of Test for Mass Color and Tinting Strength of Color Pigments (D 387 - 36).
3-39	Method of Evaluating Degree of Resistance to Rusting Obtained with Paint on Iron or Steel Surfaces (D 610 - 43).

4-39	Method of Evaluating Degree of Resistance to Chalking of Exterior Paints of the Linseed-Oil Type (D 659 - 44).
5-39	Method of Evaluating Degree of Resistance to Checking of Exterior Paints of the Linseed-Oil Type (D 660 - 44).
6-39	Method of Evaluating Degree of Resistance to Cracking of Exterior Paints of the Linseed-Oil Type (D 661 - 44).
7-39	Method of Evaluating Degree of Resistance to Erosion of Exterior Paints of the Linseed-Oil Type (D 662 - 44).
8-39	Methods of Evaluating Degree of Resistance to Flaking (Scaling) of Exterior Paints of the Linseed-Oil Type (D 772 - 47).
9-47	Method of Permeability to Moisture of Organic Surface Coatings.
10-48	Method of Test for Fineness of Dispersion of Pigmented Protective or Decorative Coatings.
11-48	Method of Test for Flash Point by Means of the Tag Closed Tester (D 56 - 36).
12-48	Method of Test for Distillation of Gasoline, Naphtha, Kerosine, and Similar Petroleum Products (D 86 - 46).
13-49	Methods of Testing Soluble Nitrocellulose Base Solutions (D 365 - 39).
14-49	Specifications for Black Synthetic Iron Oxide (D 769 - 48).
15-49	Specifications for Pumice Pigment (D 867 - 48).
16-49	Method of Evaluating Degree of Resistance of Traffic Paint to Bleeding (D 868 - 48).
17-49	Methods of Test for Evaluating Degree of Settling of Traffic Paint (D 869 - 48).
18-49	Methods of Sampling and Testing Turpentine (D 233-48).
19-49	Methods of Testing Cellulose Acetate (D 871 - 48).
20-49	Specifications for Titanium Dioxide Pigments (D 476 - 48).
21-49	Specifications for Raw and Burnt Umber (D 763 - 48).
22-49	Specifications for Raw and Burnt Sienna (D 765 - 48).
23-49	Method of Test for Dry to No-Pick-Up Time of Traffic Paint (D 711 - 48).
24-49	Specifications for Orange Shellac and Other Laes (D 237 - 48).
25-49	Specifications for Raw Tung Oil (D 12 - 48).
26-49	Specifications for Raw Soybean Oil (D 124 - 48).
27-49	Specifications for Perilla Oil, Raw or Refined (D 125 - 48).
28-49	Specifications for Raw Linseed Oil (D 234 - 48).
29-49	Specifications for Boiled Linseed Oil (D 260 - 48).
30-49	Methods of Sampling and Testing Lacquer Solvents and Diluents (D 268 - 49).
31-49	Specifications and Tests for Soluble Nitrocellulose (D 301 - 48).
32-49	Methods of Sampling and Testing

Aluminum Powder and Paste (D 480 - 48).
33-49 Method of Test for Flash Point by Means of the Pensky-Martens Closed Tester (D 93 - 46).

The acceptance of this large number of methods by the Federation, whose membership includes the manufacturers of paint and varnish, is the result of cooperation through a Joint A.S.T.M.-F.P.V.P.C. Committee on Paint, Varnish, and Lacquer. The members of this joint committee are as follows:

M. Van Loo, Chairman
A.S.T.M. Representatives:
R. D. Bonney, Congoleum-Nairn, Inc.
H. A. Nelson,¹ New Jersey Zinc Co. (of Pa.)
C. H. Rose, National Lead Co.
F.P.V.P.C. Representatives:
M. A. Glaser, Midland Industrial Finishes Co.
R. W. Matlack, George D. Wetherill & Co., Inc.
M. Van Loo, The Sherwin-Williams Co.

The chairmanship of this joint committee alternates annually between the Federation and A.S.T.M. representatives.

New and revised standards are submitted to the constituent organization through the Joint Committee. The A.S.T.M. through its Committee D-1 on Paint, Varnish, Lacquer, and Related Products has under consideration Federation Methods 9-47 for Permeability of Moisture and 10-48 for Fineness, and in addition is studying a new Method for Viscosity by Means of the Ford Viscosity Cup proposed by the Federation. The Federation through its Committee on Standards and Methods of Test, under the chairmanship of M. A. Glaser, is now giving consideration to approval of the following five A.S.T.M. Methods:

Method of Test for Hygroscopic Moisture (And Other Matter Volatile Under the Test Conditions) in Pigments (D 280 - 33).
Method of Test for Acetone Number of Heat-Bodied Drying Oils (D 555 - 49 T).
Method for Evaluating Paints on Metal When Subjected to Immersion or Other Exposure to Moisture or Liquids (D 714 - 45).
Method of Test for Heat Bodying Rate of Drying Oils (D 967 - 48 T).
Method of Test for Aniline Point and Mixed Aniline Point of Hydrocarbon Solvents (D 1012 - 49 T).

¹ Deceased.

NEW PUBLICATIONS

New Symposiums and Compilations Now Available

IN RECENT weeks quite a few A.S.T.M. publications have made their appearance. Several technical symposiums which include "High Additive Content Oils" and "Dynamic Stress Determinations" have already become available. Compilations on Cement; Mineral Aggregates, Concrete, and Nonbituminous Highway Materials; Glass Products; Electrical Insulating Materials, and Rubber Products are available. Within a matter of days the current edition of the Compilation on Plastics will also be out. Brief reviews of these symposiums and compilations are offered below.

The "Index to the 1949 Book of Standards" is at the printers now and by the time the September BULLETIN is issued it should be available to members. The Index should continue to fill a need since it contains a chronological, numerical listing of all A.S.T.M. standards and tentative methods and specifications. In addition, the various standards are also listed under the major subdivisions of the materials of engineering such as, ferrous and non-ferrous metals; concrete; plastics, and so forth. They have been indexed under appropriate key words. The items under each key word are arranged alphabetically according to the significant word in the title.

High Additive Content Oils:

This symposium, presented at the First Pacific Area National Meeting, last fall, covers lubricating oils of an entirely new type. These oils differ from the previous heavy-duty oils in that they contain from five to ten times as much additive. They were developed to meet a field condition involving severe operation of engines using high sulfur fuels.

The success of these oils has led investigators to determine if other problems, such as sludging and piston and valve deposits, in other than tractor engines, could also be corrected by the use of these oils. This is the first time that actual field service data on high additive oils have been published, and the papers and formal discussions contained in this symposium should give a well-rounded presentation from the standpoint of both the equipment and lubricants manufacturers.

Papers included in the symposium are entitled: "Does Service Performance Justify Higher Quality Lubricating Oils?" by W. B. Bassett, Lubrizol Corp.; "High Detergency Motor Oils" by A. B. Boehm,

Enjay Co., and C. O. Tongberg, Standard Oil Development Co.; "Five Years Experience with Special Heavy Duty Oils" by R. E. Jeffrey and J. A. Edgar, Shell Oil Co., Inc., and "Possible Future Military Engine Oils" by N. L. Klein, Department of the Army. A short introduction by A. H. Batchelder of the California Research Corp. is also included.

The 68-page symposium, "High Additive Content Oils—STP 102," is \$1.75; the price to A.S.T.M. members is \$1.35.

Dynamic Stress Determinations:

During recent years many types of new equipment and new techniques have been developed for making and interpreting dynamic measurements. Most of these developments have involved electrical or electronic devices and a field of specialization generally unfamiliar to engineers concerned with research upon materials and structures. Investigation of dynamic conditions has become increasingly important. Until now no single source of information has been available that presented the scope, applicability, possibilities and limitations of electronic measuring and recording devices. It is hoped that this symposium with its group of four papers will assist the individual who may be responsible for initiating such tests, or who may have to make practical application of the results of such tests. These papers were written to include the phenomena associated with the dynamic state of principal interest to engineers in the field of materials and structures. Specifically, the papers contained in the symposium, together with their authors and the appropriate discussion which followed the papers when they were presented at the First Pacific Area National Meeting in San Francisco, appear below:

"Pick-ups for Dynamic Physical Measurements" by Gifford White, Statham Laboratories; "Recording Equipment for Dynamic Testing" by K. D. Swartzel, Cornell Aeronautical Laboratory, Inc.; "Analysis and Interpretation of Dynamic Records" by H. C. Roberts, University of Illinois; and "Dynamic Testing in the Field of Materials and Structures" by Douglas McHenry and H. E. Hosticka, U. S. Bureau of Reclamation.

The 68-page symposium, "Dynamic Stress Determinations—STP 104," is \$1.50; the price to A.S.T.M. members \$1.15.

Cement:

For many years specifications and test methods issued by the Society have been used to govern the manufacture of much of the cement that has been produced.

While all of these standards are published in other volumes issued by the Society and copies are available in separate form, there is no source so convenient as this special compilation. It is of considerable utility to all who are concerned with these widely used and important engineering materials.

The tenth issue of the compilation on Cement includes two new tentatives—Specifications for Air-Entraining Additions for Use in the Manufacture of Air-Entraining Portland Cement (C 226 - 50 T), and Method of Test for Determining the Potential Alkali Reactivity of Cement-Aggregative Combinations (C 227 - 50 T).

The other 22 A.S.T.M. specifications and tests concern portland, portland blast, furnace slag, natural, masonry, and air-entraining portland cement.

The Manual of Cement Testing in an appendix to the compilation provides helpful information on this subject; information on Balances and Weights and an extensive list of references are also included as appendices.

About 200 pages, the paper bound compilation is \$2. The price to members of A.S.T.M. is \$1.50.

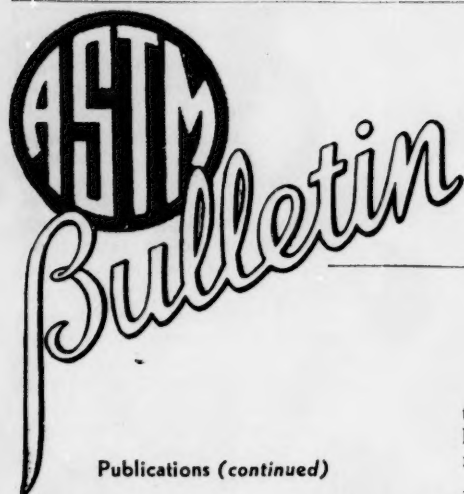
Mineral Aggregates, Concrete, and Nonbituminous Highway Materials:

The compilation—Mineral Aggregates, Concrete, and Nonbituminous Highway Materials—is sponsored by Committee C-9 on Concrete and Concrete Aggregates and Committee D-4 on Road and Paving Materials and also includes a few pertinent specifications under the jurisdiction of Committee C-1 on Cement.

It should be useful to producers and consumers, as well as specification writers, testing and inspection personnel, and to research and engineering institutions.

There are about 80 test methods and definitions in their latest approved form. Included in these are specifications for concrete, brick, granite block, concrete aggregates (crushed stone, slag, gravel, etc.) cement, mineral filler for sheet asphalt, and sand. The test methods on concrete aggregates include those on abrasion, fineness, clay lumps, coal and lignite in sand, specific gravity, moisture, unit weight of aggregate, and voids. On concrete, the methods include those on air content, compressive and flexural strength, flow, slump, sampling, and specific gravity, as well as many others.

Sampling and testing calcium chloride, and testing of expansion joint fillers, and water retention efficiency of curing methods are included. About 240 pages, the compilation is \$2.25—\$1.75 to A.S.T.M. members.



JULY 1950

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Publications (continued)

Glass Products:

The up-to-date standards representing cement practices of the glass industry are contained in this compilation. They have been prepared by the membership of Committee C-14 and its subcommittees—competent authorities on glass and glass products from consumer and producer interests of the industry.

Included are the specifications for lime-glass insulators and methods for analyzing glass sand and soda-lime glass. Many tests for glass containers, a procedure for sampling glass containers, and tests for glass spool insulators, yarn, fabrics, tapes, and braids are also included.

There are complete references to allied standards which have been developed by other committees of the Society.

The compilation is paper bound and contains 85 pages—\$1.50. To A.S.T.M. members, the price is \$1.15.

Electrical Insulating Materials:

Under one cover are all of the important standard specifications and tests together with special sections on significance of tests.

This compilation, prepared by Committee D-9 on Electrical Insulating Materials, is a collection that reflects long experience in the study of characteristics of electrical insulating materials—study coupled with sound engineering development. These specifications represent the fairness insured by the A.S.T.M. committee system which assures adequate consumer and producer interest as a document is prepared and strengthened through the years.

In the present volume, standards cover insulating varnishes, paints, and lacquers, plastic types of plates, sheets, rods, and tubes, mineral insulation oils, glass, porcelain, steatite, filling and treating compounds, insulating fabrics and papers, mica products, rubber products and applicable textiles. Testing methods for physical and chemical properties and performance of all these, and procedures for standardizing the conditions under which the tests for qualities are made are also included. The scope of Committee D-9's work, its personnel, and regulations are included.

The 670 pages are well worth the \$4.85, to those concerned with electrical insulating materials. The special price to members is \$3.65.

Rubber Products:

Technologists, sales engineers—all who are concerned with production or consumption of rubber—should find the present issue of this compilation to be conveniently useful. The publication is under the auspices of Committee D-11 on Rubber and Rubber like Materials. This year some 100 standards in 625 pages delineate a broad field of materials.

Included are processibility tests, methods of sampling and chemical analysis, and numerous physical tests. The latter cover hardness, tear, tension, adhesion, cure, etc., and there are aging and weathering tests, low-temperature tests, electrical tests, and standard nomenclature and definitions.

Groups of specifications cover automotive and aeronautical rubber, rubber hose and belting, gloves, matting, tape, rubber-coated fabrics, insulated wire and cable, hard and cellular rubber, rubber cements and lattices, packing materials, nonrigid plastics, electrical tests.

The Rubber Products compilation is 625 pages; \$4.75 to nonmembers and \$3.50 to members.

Plastics:

With a dozen new tentatives which indicate the continuing technological expansion of the plastics field, and with all its older standards in their latest approved form, the new plastics compilation should be even more useful than before.

Almost 700 pages attest to the wide scope and joint efforts of Committee D-20 on Plastics, and D-9 on Electrical Insulating Materials in the materials engineering part of the plastics industry.

There are specifications and quality testing methods for the major families of plastics. Performance tests are included for determination of brittleness, flammability, mar resistance, stiffness, haze, and a host of other qualities. The nomenclature and definitions on plastics and plastic terms are covered thoroughly.

The 680-page compilation on plastics is \$4.85 to nonmembers and \$3.65 to members.

September 1—Last Day for Annual Meeting Papers Discussion

MUCH of the discussion of technical papers and reports published in the *Proceedings* is submitted after the meeting "by letter." Written discussion of papers and reports presented at the 1950 Annual Meeting in Atlantic City will be received by the Committee on Papers and Publications until September 1. It will be greatly appreciated if all who plan to submit such discussion will do so well in advance of this date so that additional time is available for review and submission to authors for closure.

Schedule of A.S.T.M. Meetings

DATE	GROUP	PLACE
September 11-12	Board of Directors	(A.S.T.M. Headquarters)
October 8-11	Committee D-2 on Petroleum Products and Lubricants	Detroit, Mich.
October 12-13	Committee D-10 on Shipping Containers	(A.S.T.M. Headquarters)
October 13	Ohio Valley District	Columbus, Ohio
October 18-20	Committee D-13 on Textile Materials	New York, N. Y.
October 19-20 (Tentative)	Committee D-14 on Adhesives	Boston, Mass.
October 23-25	Committee C-16 on Thermal Insulating Materials	Asbury Park, N. J.
October 26-27	Committee C-19 on Structural Sandwich Construction	Madison, Wis.
November 14-15	Committee D-20 on Plastics	Cincinnati, Ohio
November 15-17	Committee D-9 on Electrical Insulating Materials	Cincinnati, Ohio

Should Method of Acting Upon Committee Reports and Standards Be Changed?

The article reprinted below appeared in a recent issue of the A.S.T.M. Bulletin. Since the proposal deals with so basic a matter, namely, the manner in which committee recommendations are acted upon at the Annual Meeting, the Board would wish to have the benefit of comments from the members. Two letters already received at Headquarters are also reproduced here.

THOSE who have attended the annual meeting sessions over a period of years are familiar with the method of presenting committee reports and the procedure followed by the Society in taking action upon committee recommendations. In line with the procedure set forth in the by-laws of the Society, committee recommendations are presented at the annual meeting and acted upon by the members of the Society present. It has been traditional to have committee reports and technical papers presented at the same session and for a number of years when there were not so many committees from which reports were to be received, this worked out very well and the sessions were of sufficient technical interest to justify a reasonable attendance. More recently, however, the number of committee reports requiring presentation and action increased to such an extent that it became increasingly difficult to schedule them at sessions interspersed with technical papers.

Following the experience of the abbreviated wartime annual meeting held in New York in 1945, devoted entirely to committee reports, several sessions to committee reports, several sessions were arranged at the Buffalo annual meeting in 1946 consisting entirely of committee reports with as many as fifteen reports presented at a single session. At this same meeting a number of symposiums were held, and segregating the committee reports in this way contributed to very interesting and well-attended symposium and technical paper sessions. There was, however, some criticism of the report sessions as being poorly attended and lacking in interest, and in response to requests of some committees later annual meetings reverted to the earlier type of scheduling, with committee reports and technical papers interspersed. Some of the sessions have not been too successful, particularly where committee reports are scheduled in sessions where there are no papers in the same technical fields.

Studied by Board:

With this background and experience in mind, the Board of Directors has given a great deal of consideration to this entire subject, realizing the necessity for the presentation of committee reports and action on the recommendations contained therein and at the same time providing sessions that will

be of technical interest to our members. The entire procedure on the promulgation of standards as set forth in the by-laws is predicated on having this procedure democratic, not only in the consensus required in the sponsoring technical committee itself, but also in the manner in which the Society acts as a whole on standards. Recommendations covering publication as tentative only can, and are, submitted in large number to the Administrative Committee on Standards throughout the year, but this procedure is intended primarily as a means of expediting action on tentatives in the interim between annual meetings. All recommendations covering adoption as standard definitely require annual meeting action subsequently confirmed by letter ballot. It is desirable that the democratic aspect of the procedure be preserved, whereby any member of the Society has an opportunity to be heard and has a voice before the final adoption of a standards recommendation.

Review Panels Proposed:

The Board appointed a special study committee to bring in recommendations. This study committee has proposed what it terms a "review panel" procedure of review at the annual meeting in lieu of presentation before a regular annual meeting session. This proposal is set forth below as a suggested revision of the by-laws and has received favorable comment by a number of technical committee officers to whom it has been submitted. However, it has also been criticized on the score that it would not be as democratic a procedure as is now in effect, for while the members of the Society would have an opportunity to appear before the panel and present their views, they would not participate in the voting—except, of course, in the final letter ballot of the entire Society on adoption of standards. In other words, the action at the annual meeting on committee recommendations would be taken by the review panel, in a manner similar to present action on tentatives by the Administrative Committee on Standards.

The Board of Directors will welcome comments by the membership at large as to the suitability and adequacy of the proposed panel review procedure. The procedure followed by the Society in promulgation of standards is an all-

important one and it is hoped that the members will assist the Board by offering comments and suggestions.

Suggested Revisions in Article VII of By-Laws

(New wording in italics. Words in brackets to be deleted)

ARTICLE VII. PROCEDURE GOVERNING THE ADOPTION OF STANDARDS

Sec. 1.—(No change)

Sec. 2.—(No change)

Sec. 3.—(No change)

Sec. 4.—The procedure governing the promulgation of standards shall be as follows:

(a) Acceptance of tentative revisions of standards, tentatives, and revisions of tentatives, and withdrawal of standards, tentatives, and tentative revisions of standards, shall be either by action of *Review Panels at the Annual Meeting* of the Society as provided in Paragraphs (b), (c), [and] (d) and (e) or of the Administrative Committee on Standards as provided in Paragraph (f). Adoption of standards and of revisions of standards, however, shall only be by action of Review Panels [of the Society in] at the annual meeting as provided in Paragraphs (b), (c), and (d), followed by letter ballot of the Society.

(b) At the annual meeting, *Review Panels appointed by the Board of Directors shall act for the Society on all committee recommendations regarding standards. Such action shall be taken in open meetings scheduled and held during the annual meeting sessions and calculated to provide opportunity for discussion by any member of the Society. The number of Review Panels to be provided, their respective fields of coverage, their composition, their relationship to the Administrative Committee on Standards, and their rules of procedure shall be determined from time to time by the Board of Directors* [(b)] (c) An affirmative vote, [amounting to two thirds of those voting at the annual meeting], with not more than one member of the Review Panel voting negatively, shall be required on all committee recommendations, except those involving immediate adoption of standards and immediate revision of standards. (For procedure on these exceptions see Paragraph [(c)] (d).) These committee recommendations may be amended by an affirmative vote with not more than one member of the Review Panel voting negatively, and [amounting to two thirds of those voting] subject to approval of the revised recommendation by letter ballot of the committee; however, if the revised recommendation is rejected by the committee, the original committee recommendation shall be referred

to the committee for study and subsequent report [at the next annual meeting].

[c] (d) If, at an annual meeting, immediate adoption as standard is recommended, either of a proposed new standard or of a revision of an existing standard without the usual preliminary publication as tentative, [a nine-tenths rather than a two-thirds affirmative vote] a unanimous vote of the Review Panel acting on the recommendation shall be required. [In this case no amendment on the floor of the meeting shall be permitted, except with unanimous consent.]

(d) (e) [Action of the Society] Acceptance of recommendations by a Review Panel at the annual meeting on the adoption or revision of standards is subject to approval by letter ballot of the Society, an affirmative vote amounting to two thirds of those voting being required, except that in the case of the immediate adoption of a standard or of the immediate revision of a standard without the usual publication as tentative, a nine-tenths rather than two-thirds affirmative vote shall be required.

[(e)] (f) Committee recommendations on acceptance of tentative revisions of standards, tentatives and revisions of tentatives, and on withdrawal of standards, tentatives, and tentative revisions of standards, may also be presented between annual meetings to the Administrative Committee on Standards for action on behalf of the Society. The Administrative Committee on Standards shall determine whether the requirements of the Society relating to committee procedure have been met and whether the committee has reached a satisfactory consensus. During consideration of the recommendation of a technical committee, representatives of the committee may be present and participate in the discussion. If the Administrative Committee on Standards takes favorable action upon the recommendation, the technical committee shall report the action in its next annual report.

Letters Received from Members

Dear Sir:

This proposed procedure appears to have advantages over the present one in that only those interested will be in attendance during presentation of Committee Reports and Standards, and also a given number of informed A.S.T.M. members, who constitute the 'review panel,' will have the responsibility of giving special, critical attention to the material being presented by the respective committee chairmen. Segregation of the Committee Reports will no doubt result in better-attended and more interesting symposia and technical paper sessions at the annual Society meetings.

"However, there are two important points that should be considered. One is that the various committees should be represented on the 'review panels,' somewhat in proportion to their size and activity. For example several of the 'C' committees are quite large and active, and a 'review panel' could be appointed that would consist entirely of 'C' committee members and

would review Committee Reports and Standards of these committees only. In selecting the personnel for the panels an attempt should be made to have a balance between consumer, producer, and general interest groups.

Very truly yours,
(signed) W. J. McCoy

Dear Sir:

Commenting on the Society's question "Should Method of Acting Upon Committee Reports and Standards Be Changed?" I feel that the present democratic procedure should be retained in so far as possible. There has been enough curtailment of our democratic liberties in our National Government; let us not, therefore, voluntarily surrender the few remaining to us in our private lives.

It is realized that the Society membership has grown to a point where the actual mechanics of establishing new and revised standards and methods of test has or soon will become cumbersome. The proposed "Review Panel," presumably to be appointed by the directors or an appointed committee of same, will alleviate this situation but at a sacrifice in democratic procedure. Why not apply the representative town meeting idea so successfully used in many medium-sized towns in this country?

Under this proposal, the so-called Review Panel will be increased in numbers in order to assure that every minority group will have a chance to be represented. Nominees will be appointed by a nominating committee in proportion to membership of the various A.S.T.M. committees and shall be elected to office by the Proportional Representation system of balloting. Obviously the number of nominees should exceed the number of seats to be filled so that the voting A.S.T.M. membership will be able to make an actual selection or choice of representatives. The Proportional Representation system would be essential to the working of this plan since it assures maximum minority representation and eliminates the need for primaries, election campaigns, etc.; in other words, eliminates politics.

Is this not an ideal opportunity for the A.S.T.M. to fulfill its implied obligations to society as a whole by taking the lead in demonstrating the application of our democratic principles to our every day affairs?

Very truly yours,
(Signed) FRANCIS J. MARDULIER

Manual of Open Die Forgings

The purpose of this manual is to describe the methods, practices, specifications, and inspection used in the manufacture of open-die ferrous forgings, and to explain and clarify the existing terminology of the art.

Improved methods and practices evolved through the years, and new products and applications developed, often make it difficult to apply old terms to changed conditions. Furthermore, the meaning of some words commonly used by the forging industry is sometimes at variance with dictionary definitions. It is therefore desirable that manufacturers, engineers, and consumers alike have the benefit of a common terminology.

Recognizing this need, this manual has been prepared by a committee gathered without restriction from companies manufacturing open-die forgings. The committee has drawn freely from information made available by groups such as the American Society for Metals, American Society for Testing Materials, American Iron and Steel Institute, United States Army, United States Navy, Battelle Memorial Institute, and other recognized agencies and individuals.

Three chapters are included covering manufacturing practices, specifications and testing, and conditions which may be detrimental to service life. Also in the book are a glossary of selected iron and steel terms and definitions as applied to open-die forgings and eleven tables of interest and direct use to individuals engaged in the forging industry. Copies of this 196-page manual may be obtained from the Open Die Forgings Industry, 366 Madison Ave., New York 17, N. Y., at \$3 per copy.

The Bricklayer Trade Theory Manual

A VERY comprehensive manual in two volumes has been published by the Carnegie-Illinois Steel Corp., for trade apprentice training in the art of bricklaying as it applies to the steel industry. This means, of course, that the coverage pertains chiefly to refractory materials rather than other type of construction. Volume I covers the basic aspects of masonry theory including common terms, care and use of tools and equipment, properties and use of materials, and the less complex methods and practices. Volume II presents advanced trade theory including the more complex methods and practices of masonry.

Reference is made to the standard testing methods as developed by Committee C-8 of the Society and that they are the best available standards that have been developed upon which to judge the merits of any given refractory. A series of sections covering the various types of steel furnaces makes use of reprinted portions of the Manual on A.S.T.M. Standards on Refractories covering industrial surveys of these types of furnaces.

Pacific Area Papers

IN ORDER to keep the membership informed as to the availability of papers which were presented at the First Pacific Area Meeting of the

Society last fall, there follows a table which summarizes the status of these papers which have been published or which will appear shortly.

All of the papers' titles and their authors are listed in the 1949 *Proceedings* of the Society, starting on p. 119.

TABLE.—RÉSUMÉ OF WEST COAST PAPERS PUBLICATION AVAILABILITY.

Title of Paper	Authorship	Publication Medium	Date Published
Fatigue of Metals			
Discussions of a Century Ago Concerning the Nature of Fatigue and Review of Some of the Subsequent Researches Concerning the Mechanism of Fatigue	R. E. Peterson	ASTM BULLETIN	February, 1950
Fatigue Characteristics of Aircraft Materials and Fastenings	T. Piper, K. F. Finlay, and A. P. Binsacca	ASTM BULLETIN	May, 1950
Soils			
Studies of Construction Methods and Methods of Compacting Different Type of Soils to Optimum Density	A. W. Root, W. S. Maxwell, and T. E. Stanton	Appeared in <i>Western Construction News</i> in somewhat modified form.	May 15, 1950
Dynamic Stress Determination			
Survey of Pick-Ups for Dynamic Physical Measurements	Gifford White	Special Technical Publication <i>STP No. 104</i>	June, 1950
Selection of Recording Equipment for Dynamic Testing	K. D. Swartzel		
Analysis and Interpretation of Dynamic Records	H. C. Roberts		
Some Examples of Dynamic Testing in the Field of Material and Structures	Douglas McHenry and H. E. Hosticka		
Brick Masonry			
Design Construction and Properties of Reinforced Grouted Brick Masonry	N. W. Kelch	ASTM BULLETIN	September, 1950
Application of Statistics			
Economic Relationship Between Design and Acceptance Specifications	E. L. Grant	Special Technical Publication <i>STP No. 103</i>	August, 1950
Precision and Accuracy of Test Methods	Grant Wernimont		
Use of Statistics to Determine Accuracy of Tentative Test Methods	W. J. Youden and J. M. Cameron		
High Additive Oils			
Does Service Performance Justify Higher Lubricating Oils?	W. B. Bassett	Special Technical Publication <i>STP No. 102</i>	June, 1950
How Detergency Motor Oils	A. B. Boehm and C. O. Tongberg		
Five Years Experience with Special Heavy Duty Oils	R. E. Jeffrey and J. A. Edgar		
Possible Future Military Engine Oils	N. L. Klein		
Turbine Oils			
Lubrication Problems and Requirements of Gas Turbine Equipment	F. C. Linn	Special Technical Publication	August, 1950
Operating Experience and Problems Relative to Lubricating Systems of Steam Turbine Sets for Utilities	V. Estcourt		
Special Problems Pertaining to Lubrication of Industrial Turbines	A. S. Morrow		
Lubricating of Marine Turbine Propulsion Equipment	F. S. Jones		
Pozzolans			
Pozzolanic Materials and Their Use in Concretes	R. E. Davis	Special Technical Publication <i>STP No. 99</i>	August, 1950
Pozzolans Used in Mass Concrete	H. S. Messner		
Experience with Kansas Aggregates and Pozzolanic Additions	C. H. Scholer		
Effect of Calcination on Natural Pozzolans	R. C. Mielenz, O. J. Glantz, and L. P. White		
Effect of the Use of Diatomite Treated with Air-Entraining Agents Upon the Properties of Concrete	R. E. Davis, and Alexander Klein		
Summary of Methods for Determining Pozzolanic Activity	W. T. Moran and J. L. Gilliland		
Strength, Volume Change, and Sulfate Resistance of Mortars Containing Portland Pozzolan Cements	R. E. Davis, W. C. Hanna, and E. H. Brown		
Studies of Some Methods of Avoiding Expansion and Pattern Cracking Associated with the Alkali Aggregate Reaction	W. C. Lerch		
Studies of Use of Pozzolans for Counteracting Excessive Concrete Expansion Resulting from Reaction Between Aggregate and Alkalies in Cement	T. E. Stanton		
Paint			
Fire-Resistant Finishes for Aircraft	J. A. Jones and R. V. Niswander	ASTM BULLETIN	May, 1950
Laboratory Tests of Protective Coatings Versus Service Results	W. T. Moran and G. E. Burnett	ASTM BULLETIN	April, 1950
Methods of Evaluation of Aircraft Primers	E. T. Nelson	ASTM BULLETIN	July, 1950
Cast Iron			
Mechanical Testing and Properties of Gray Cast Iron	C. K. Donoho	These papers will appear in forthcoming issues of <i>Foundry Magazine</i> .	
Development, Significance, and Uses of Specifications for Cast Iron	H. Bornstein		
Automotive Cast Irons, Including Brake Drums	R. G. McElwee		
Application and Uses of Gray Iron Castings, Including Significance of Various Properties of Gray Cast Iron	C. O. Burgess		

DISTRICT ACTIVITIES

District Officers and Personnel

THE District Councils of the Society have conducted an election of officers and councilors for the ensuing term of two years, under the A.S.T.M. Charter for Districts, which has been in effect since January 1, 1947. This charter provides that councilors and officers shall be elected by the A.S.T.M. members and committee members in the respective districts. Ballots were distributed in May, and all councilors listed on the ballots on recommendation of the respective Nominating Committees were elected.

The list of officers and councilors is given below. Newly elected councilors are indicated by an asterisk (*). Terms of approximately one half of the councilors expire each June.

Several of the districts have already

planned fall meetings, and members are urged to watch ensuing BULLETINS for specific dates and topics of meetings to be sponsored.

As soon as possible after meeting details are definite, each member and committee member in the specific area receives a direct-mail notice, and usually other groups of technical men in this area concerned with the subject under discussion are also invited.

A complete list of district councilors will appear in the 1950 Year Book. Many of the councilors' terms carry through 1951, and the list below notes *only newly elected councilors and re-elections of those whose terms expired in 1950*. The list is *complete*, however, for chairman and other district officers.

List of New or Re-elected District Councilors as of June, 1950

(For complete list see 1950 Year Book, now in preparation)

Chicago

Chairman: J. E. Ott, Acme Steel Co., 2834 Archer Ave., Chicago 8, Ill.; **Vice-Chairman:** G. E. Stryker, Bell & Howell Co., 7100 McCormick Blvd., Chicago 45, Ill.; **Secretary:** D. D. Rubek, Anderson-Prichard Oil Corp., 3921 N. Ravenswood Ave., Chicago 13, Ill.

Councilors: C. E. Ambelang, Public Service Co. of Northern Ill.; B. J. Barmack,* Commonwealth Edison Co.; E. E. Chapman, Atchison, Topeka & Santa Fe Railway; H. B. Emerson, Lehigh Portland Cement Co.; J. T. Jarman, Allis-Chalmers Mfg. Co.; J. J. Kanter, Crane Co.; G. G. Lamb, Northwestern Technological Institute; J. deN. Macomb (Retired); V. C. Mehlenbacher, Swift and Co.; C. A. Menzel, Portland Cement Assn.; H. G. Miller, Chicago, Milwaukee, St. Paul & Pacific R.R. Co.; H. H. Morgan, Robert W. Hunt Co.; F. A. Randall, Frank A. Randall and Sons; M. N. States, Central Scientific Co.; G. E. Stryker, Bell & Howell Co.

Cleveland

Chairman: R. T. Bayless, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; **Vice-Chairman:** H. P. Ferguson, Standard Oil Co., Ohio, Midland Building, Cleveland 15, Ohio; **Secretary:** L. F. Herron, The James H. Herron Co., 1360 W. Third St., Cleveland 13, Ohio.

Councilors: J. S. Adelson, Steel and Tubes Div., Republic Steel Corp.; R. T.

Bayless, American Society for Metals; A. W. Carpenter, The B. F. Goodrich Co.; J. V. Emmons, The Cleveland Twist Drill Co.; H. P. Ferguson, Standard Oil Co. Ohio; Emil Kline,*† Industrial Rayon Corp.; E. G. Kimmich, The Goodyear Tire & Rubber Co.; Joseph Prescott,* Cleveland Electric Illuminating Co.; H. W. Dell,* The Glidden Co.; F. G. Steinebach, Penton Publishing Co.; A. J. Tuscany, Arthur J. Tuscany Organization; R. L. Wilson, Timken Roller Bearing Co.; George Yearley, True Temper Corp.

Detroit

Chairman: W. R. Fraser, Michigan Consolidated Gas Co., 415 Clifford St., Detroit 26, Mich.; **Vice-Chairman:** D. M. McCutcheon, Ford Motor Co., Applied Physics Lab., 2674 Schaefer Rd., Dearborn, Mich.; **Secretary:** F. C. Kennedy, U. S. Rubber Co., 6600 E. Jefferson Ave., Detroit 32, Mich.

Councilors: C. O. Durbin,* Chrysler Corp.; W. R. Fraser, Michigan Consolidated Gas Co.; C. M. Gambrill, Ethyl Corp.; A. J. Herzig, Climax Molybdenum Co. of Mich., Inc.; C. E. Heussner, Chrysler Corp.; D. M. McCutcheon, Ford Motor Co.; D. J. McKinnon,* Detroit Steel Products Co.; R. I. Peters,* Ditzler Color Div., Pittsburgh Plate Glass Co.; R. B. Saltonstall,* The Udylyte Corp.; C. A. Siebert, University of Michigan; G. B. Watkins, Libbey-Owens-Ford Glass Co.; H. R. Wolf, General Motors Corp.

New England

Chairman: H. H. Lester, Watertown Arsenal, Research Division, Watertown 72 Mass.; **Vice-Chairman:** Prof. E. A. Gramstorff, Northeastern University, Boston, Mass.; **Secretary:** C. G. Lutts, Boston Naval Shipyard, Building 34, Boston 29, Mass.

Councilors: H. J. Ball, Lowell Textile Institute; M. N. Clair, The Thompson and Lichtner Co., Inc.; R. C. Corson,* Associated Factory Mutual Fire Insurance Cos.; Daniel Cushing, Consulting Metallurgical Engineer; A. G. H. Dietz, Massachusetts Institute of Technology; E. N. Downing, General Electric Co.; E. A. Gramstorff, Northeastern University; C. G. Lutts, Boston Naval Shipyard; J. E. McGuire,* American Tar Co.; G. P. Swift, Consulting Engineer.

New York

Chairman: H. C. R. Carlson, The Carlson Co., 277 Broadway, New York 7, N. Y.; **Vice-Chairman:** G. O. Hiers, National Lead Co., 105 York St., Brooklyn 1, N. Y.; **Secretary:** S. R. Donner, Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Box 419, Passaic, N. J.; **Secretary:** A. A. Jones, Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.

Councilors: A. G. Ashcroft, Alexander Smith & Sons Carpet Co.; H. C. R. Carlson, The Carlson Co.; W. F. Collins, New York Central System; W. T. Cruise,* Society of the Plastics Industry; M. P. Davis, Otis Elevator Co.; J. C. Fox, Doehler-Jarvis Corp.; Ephraim Freedman, Macy's; G. O. Hiers, National Lead Co.; E. P. Pitman, Port of New York Authority; E. A. Snyder, Socony-Vacuum Oil Co., Inc.; Jerome Strauss,* Vanadium Corp. of America; Gordon Thompson, Electrical Testing Labs., Inc.; E. R. Thomas, Consolidated Edison Co. of New York; J. R. Townsend, Bell Telephone Labs., Inc.; J. S. Vanick, The International Nickel Co., Inc.; R. W. Wilhelm, Miller & Weber

Northern California

Chairman: L. A. O'Leary, W. P. Fuller and Co., South San Francisco, Calif.; **Vice-Chairman:** P. V. Garin, Southern Pacific Co., 65 Market St., San Francisco 5, Calif.; **Secretary:** H. P. Hoopes, The Paraffine Cos., Inc., Powell St., Emeryville, Calif.

Councilors: R. N. Conner,* The Baldwin Locomotive Works; F. C. Cook, Robert W. Hunt Co.; S. L. Davidson,*† National Lead Co.; H. de Bussieres,* Curtis and Tompkins; T. P. Dresser, Abbot A. Hanks, Inc.; Dozier Finley, Research Consultant; P. V. Garin, Southern Pacific Co.; F. M. Harris, Pacific Gas & Electric Co.; H. P. Hoopes,* The Paraf-

fine Cos., Inc.; J. T. Kemp,* American Brass Co.; M. C. Poulsen, Port Costa Brick Works; G. H. Raitt,† Consolidated Western Steel Corp.; Carey Ramey,* Standard Oil Co. of Calif.; H. A. Sawin,* Yuba Manufacturing Co.; F. C. Smith,* Bethlehem Pacific Coast Steel Corp.; H. A. Williams,† Stanford University.

Ohio Valley

Chairman: J. C. Harris, Monsanto Chemical Co., Nicholas Road, Dayton 7, Ohio; **Vice-Chairman:** J. H. Calbeck, American Zinc Sales Co., Box 327, Columbus 16, Ohio; **Secretary:** J. C. Pitzer, The Formica Insulation Co., 4614 Spring Grove Ave., Cincinnati 32, Ohio.

(The election of officers and councilors of this district was held as part of the formal organization late in 1949, the terms carrying through June, 1951. Complete personnel will be shown in the 1950 Year Book.)

Philadelphia

Chairman: A. O. Schaefer, Midvale Co., Philadelphia 40, Pa.; **Vice-Chairman:** E. J. Albert, Thwing-Albert Instrument Co., Penn St. and Pulaski Ave., Philadelphia 44, Pa.; **Vice-Chairman:** E. K. Spring, Henry Disston & Sons, Inc., Unruh and Milnor Sts., Philadelphia 35, Pa.; **Secretary:** Tinius Olsen 2nd, Tinius Olsen Testing Machine Co., Easton Road, Willow Grove, Pa.

Councilors: E. J. Albert, Thwing-Albert Instrument Co.; W. J. DeMauiac,* Philadelphia Electric Co.; Henry Grinsfelder, The Resinous Products Div., Rohm & Haas Co.; H. M. Hancock, The Atlantic Refining Co.; E. O. Hausmann, Continental Diamond Fibre Co.; C. R. Hutcheroff, Keasby & Mattison Co.; G. H. Mains, National Vulcanized Fibre Co.; Tinius Olsen 2nd, Tinius Olsen Testing Machine Co.; R. B. Rohrer, Armstrong Cork Co.; A. O. Schaefer, Midvale Co.; E. K. Spring, Henry Disston & Sons, Inc.; H. W. Stuart, U. S. Pipe & Foundry Co.; F. G. Tatnall, Baldwin-Locomotive Works; J. F. Vogdes, Jr., Engineer.

Pittsburgh

Chairman: M. D. Baker, West Penn Power Company, Box 98, Springdale, Pa.; **Vice-Chairman:** F. T. Mavis, Carnegie Institute of Technology, Pittsburgh 13, Pa.; **Secretary:** H. F. Hebley, Pittsburgh Consolidated Coal Co., 2045 Koppers Bldg., Pittsburgh, Pa.

Councilors: M. D. Baker, West Penn Power Co.; R. E. Birch,* Harbison Walker Refractories Co.; J. J. Bowman, Aluminum Company of America; H. F. Hebley, Pittsburgh Consolidated Coal Co.; J. W. Hepplewhite,* The Edwin M. Knowles China Co.; C. J. Livingstone,* Gulf Oil Corp.; R. B. Mears,* Carnegie Illinois Steel Corp.; C. L. Potter,* Jones & Laughlin Steel Corp.; E. O. Rhodes,* Koppers Co., Inc.; Vic Sanders,* Pittsburgh Corning Corp.; Mary E. Wargia, University of Pittsburgh; M. C. Wylie, Gulick-Henderson Co., Inc.

St. Louis

Chairman: S. B. Roberts, Robert W. Hunt Co., 2008 Olive St., St. Louis 3, Mo.;

Vice-Chairman: J. M. Wendling, City of St. Louis, Municipal Testing Lab., 55 Municipal Courts Bldg., St. Louis 3, Mo.; **Secretary:** W. C. Magruder, Carter Carburetor Co., 2840 N. Spring St., St. Louis 7, Mo.

Councilors: A. W. Brust, Washington University; L. C. Hewitt, Laclede-Christy Co.; J. C. Hostetter, Mississippi Glass Co.; Joseph Kohlberg,* The Laclede Gas Light Co.; E. C. Meinholtz,* Missouri Pacific Lines; S. B. Roberts, Robert W. Hunt Co.; A. F. Schwartz, Jr.,* Russell, Crowell, Mullgardt & Schwartz; H. W. Russell,* Illinois State Div. of Highways; E. B. Seaton, Monsanto Chemical Co.; E. J. Sheppard, National Lead Co.; L. A. Wagner, Missouri Portland Cement Co.; J. M. Wendling, City of St. Louis; H. E. Wiedemann, Consulting Chemist.

Southern California

Chairman: H. W. Jewell, Pacific Clay Products, 306 W. Avenue 26, Los Angeles 31, Calif.; **Vice-Chairman:** C. M. Wake-man, Los Angeles Harbor Dept., Box 786, Wilmington, Calif.; **Secretary:** M. B. Niesley, California Testing Labs., 1429 Santa Fe Ave., Los Angeles 21, Calif.

Councilors: F. J. Converse, California Institute of Technology; John Delmonte,* Plastics Institute; C. E. Emmons, The Texas Company; W. C. Hanna, California Portland Cement Co.; H. W. Jewell, Pacific Clay Products; R. C. Madden,* Kaiser Company; M. B. Niesley,* California Testing Labs.; R. B. Stringfield, Consultant; J. T. Young, City of Los Angeles, Bureau of Standards.

Washington (D. C.)

Chairman: G. M. Kline, National Bureau of Standards, Organic Plastics Section, Washington, D. C.; **Vice-Chairman:** E. F. Kelley, Bureau of Public Roads, Division of Physical Research, Federal Works Agency, Washington 25, D. C.; **Vice-Chairman:** C. M. Hewett, Mexican Petroleum Corp., Box 1417, Baltimore 26, Md.; **Vice-Chairman:** A. B. Cornthwaite, Virginia Dept. of Highways, 1221 East Broad St., Richmond 19, Va.; **Secretary:** L. W. Ball, Physics Research Dept., Naval Ordnance Laboratory, White Oak, Md.

Councilors: L. W. Ball, Naval Ordnance Lab.; R. C. Brand,* Standard Lime and Stone Co.; F. B. Brown,* Wire Reinforcement Institute; Fred Burggraf,* National Research Council; A. B. Cornthwaite,* Virginia Dept. of Highways; G. H. Dent,* The Asphalt Institute; J. R. Dwyer,* National Bureau of Standards; B. D. Greenshields,* George Washington University; Herbert Inley,* National Bureau of Standards; H. J. Kirk,* Assoc. General Contractors of America, Inc.; E. F. Kelley, Bureau of Public Roads; G. M. Kline, National Bureau of Standards; R. A. Marr,* Virginia Military Institute; E. F. Preece,* National Park Service; J. E. Wood,* Maryland State Roads Commission; K. E. Wright,* U. S. Navy, Bureau of Yards and Docks.

Western New York-Ontario

Chairman: L. F. Hoyt, National Aniline Div., Allied Chemical & Dye Corp., Box 975, Buffalo 5, N. Y.; **Vice-Chairman:** Joseph Gentile, Pittsburgh Testing Laboratory, 257 Franklin St., Buffalo 2, N. Y.; **Vice-Chairman:** Louis Shnidman, Rochester Gas & Electric Corp., 89 East Ave., Rochester 4, N. Y.; **Secretary:** F. A. Webber, Wickwire Spencer Steel Div., The Colorado Fuel and Iron Corp., Station B, Buffalo 7, N. Y.

Councilors: J. G. Augenstein,*† U. S. Rubber Reclaiming Co.; O. W. Ellis, Ontario Research Foundation; L. V. Foster, Bausch & Lomb Optical Co.; G. J. Gaukroger,* McKinnon Industries, Ltd.; Joseph Gentile, Pittsburgh Testing Lab.; L. F. Hoyt, National Aniline Div., Allied Chemical & Dye Corp.; R. A. Kunderling, Dominion Rubber Co.; Clarence Lamoreaux,* Federal Portland Cement Co.; G. S. Mallett,*† Anaconda American Brass, Ltd.; T. L. Mayer, Buffalo Public Library; Alden Merrill, The American Brass Co.; Charles Miserentino,*† Dunlop Tire & Rubber Corp.; O. M. O'Neill, Niagara Alkali Co.; C. L. Pope,* Eastman Kodak Co.; F. C. Rutherford,*† Lightning Fastener Co., Ltd.; P. L. Suter,*† National Aniline Div., Allied Chemical & Dye Corp.; H. G. Swan, Gould Coupler Works, Symington-Gould Corp.; R. D. Thompson,*† Taylor Instrument Co.; F. A. Webber, Wickwire Spencer Div., The Colorado Fuel & Iron Co.

* Newly elected councilors.

† Councilors elected for one-year term only.

Sources of Energy

By W. K. Lewis

Abstract

A short news account of the New England District Meeting of April 10 appeared in the May BULLETIN, but subsequently a condensed abstract of the interesting talk by Prof. W. K. Lewis was received. It is believed a number of members will find this abstract of interest.

THE use of energy in the form of fuels and water power has increased over 60-fold in this country during the last century, but in the last third of that period the rate of increase has fallen to a very low figure. The increase was negligible in the two decades preceding the outbreak of the last War. This reflects two factors: first, by 1920 the use of energy had nearly satisfied the effective demand, and, second, the technological improvement in energy utilization in recent years has greatly increased efficiency. During these two decades, the total use

of coal decreased considerably, the use of petroleum more than doubled, and that of natural gas more than trebled. During the 40's the trend was distorted by war, but all present indications point to their long-term continuance.

Meanwhile, from the point of view of available national resources, our coal supplies are adequate for a thousand years and probably longer. Our known petroleum reserves are good for only 20 to 30 years and our reserves of natural gas for not much more than that. It is true that we are discovering petroleum and natural gas today more rapidly than we are taking them out of the ground. Moreover, during the 90 years of the petroleum industry, discoveries have in the long run kept up with consumption. However, there have been times when this was not the case and when the threat of permanent shortage was serious. The danger of shortage of these fuels in this country in the not too distant future must never be overlooked. Our consumption of the fuels which, from the point of view of national resources, are in short supply is increasing, while our use of coal, the fuel of which we have an abundant amount, is not expanding and perhaps is even on the decrease. Appreciation of the nature of the problem requires understanding the characteristics of

these fuels from such points of view as storage, convenience in use, as sources of power, and interconvertibility. Superimposed on these factors are the problems of cost. Natural gas is cheapest at the source but the sources are far removed from the major markets. Its transportation costs are cheap so long as it can be transported at high load factors. Even so, the costs are not so low as they are for oil. Coal is more expensive than gas (but less than oil) at the source, but costs more to ship. On the other hand, it is more widely distributed and nearer to major sources of consumption.

The convertibility of coal into oil and gas has been developed in high degree in recent years, the work being based on the achievements of the Germans in the period between the wars. Conversion of gas to liquid fuel is under way. On the other hand, the investment costs, though not product costs, are extraordinarily high and the time factor required for development of coal as a source of liquid and gaseous fuel would be great. The solution of the problem could be left to private industry without hesitancy were it not for the complications introduced by the threat of war. To meet the national situation, national planning

of our fuel program should be made with the greatest care.

Engineering Leadership Required:

Because of the extraordinary complications of the problem, its study demands technical competence of the highest order. It is far broader than power engineering or mining or chemical engineering. It involves problems of the public interest that demand outstanding leadership. Such leadership can be furnished only by the engineering profession as a whole.

The difficulty lies in the fact that the engineering profession is not sufficiently conscious of its responsibility in a situation of this sort and is not organized to meet it. In organization, the profession is fragmented by being broken up into societies each of which deals with only a relatively narrow technical area of the engineering field. The societies are not set up to handle broad questions of public interest. What is needed for a situation of this scope is a great American Society of Engineering, of which our present engineering organizations would be technical subdivisions, each equipped to make important contributions to the solution of the problem as a whole, under the professional leadership which such an overriding organization could give.

New York District Hears About New Brooklyn Tunnel and Bus Terminal

ONE OF the most interesting district meetings of the year was sponsored by the New York District on Thursday, May 11, in the Port of New York Authority Auditorium, featuring talks by Ralph Smillie and John M. Kyle, on the new Brooklyn Battery Tunnel which was then virtually completed, and also the great new Bus Terminal being built by the Port of New York Authority. Mr. Smillie is Chief Engineer of the Triborough Bridge and Tunnel Authority, and Mr. Kyle is Chief Engineer of the Port of New York Authority.

Through the courtesy of the Port Authority, the Society was able to use its excellent auditorium with fine facilities for a meeting of this kind. Both speakers did an excellent job and both made many references to A.S.T.M.—particularly Mr. Kyle who tied in the Society's materials specifications directly with his talk. Following his discussion, E. P. Pitman, Materials Engineer of the Port Authority, and the New York District Program Chairman, showed samples of many of the materials going into the structures, all of which were covered by A.S.T.M. standards.

(The meeting notice sent out in advance was somewhat unusual—among other things, giving the alphabet with corresponding materials covered by A.S.T.M. designations. This list is given below.)

Material	A.S.T.M. Designation
A Asphalt	D 449
B Bronze	B 198
C Cement	C 150
D Drain Tile	C 4
E Electrical Cable	D 27
F Forgings	A 273
G Galvanized Steel	A 123
H Hydrated Lime	C 6
I Iron	A 48
J Joint Filler	D 241
K Keene's Cement	C 61
L Lead	B 29
M Mastic	D 491
N Nickel-Copper Alloy	B 127
O Oil	D 260
P Pitch	D 450
Q Quicklime	C 5
R Reinforcing Rods	A 15
S Structural Steel	A 7
T Turpentine	D 13
U Uniformity of Coating	A 239
V Vitified Brick	C 7
W Welding Rods	A 233
X Xylene	D 364
Y Yellow Pine	D 245
Z Zinc	B 6

Myron Park Davis, District Chairman, opened the meeting and introduced Mr. Pitman who served as Technical Chairman. A greater percentage of the excellent attendance (over 200 present) were A.S.T.M. members. Following the speakers there was a short film showing construction work carried out by the Port Authority involving airports, truck and bus terminals, tunnels, etc.

Since both the tunnel and the bus terminal, each a tremendous engineering structure, involved the use of a wide range of materials, it is believed many members will be interested in the talks; extended abstracts will appear in the September BULLETIN.

"Knowledge and Wisdom—far from being one,

Often have no connection.
Knowledge exists in heads replete
with the thoughts of other men,
Wisdom in minds attentive to their own.
Knowledge is proud that he has learned
so much,
Wisdom is humble that he knows no
more."

Quoted by H. V. Churchill in closing his address at a dinner held in connection with the conference on Applied Spectroscopy in Pittsburgh, on Feb. 15, 1950.

Air and Stream Pollution at Fall District Meetings

An interesting October meeting is in prospect sponsored by the Ohio Valley District Council. The tentative date for this meeting falls on Friday, October 13. This District meeting will be at the Ohio State University, Columbus, Ohio.

Two outstanding speakers are being procured for the Columbus meeting, one to cover Stream Pollution, the other,

Atmospheric Pollution. The Program Committee headed by C. E. MacQuigg, Dean of Engineering, Ohio State University, with H. P. Munger and J. H. Calbeck cooperating closely, plans to have panels for discussion of each of these topics following the main addresses. Leading men in each of the fields will constitute the panels.

Preceding the technical meeting and dinner on the Ohio State campus, there

is to be a special afternoon trip and visit to Battelle Memorial Institute.

In order that there would be ample accommodations in Columbus at the time of this meeting, a date was selected when Ohio State's famed football team will be playing away.

All A.S.T.M. members concerned with the meeting are urged to mark the date on their calendar. Direct mail notices will be going to all A.S.T.M. members and committee members in the district, and to other groups which would be interested.

TECHNICAL COMMITTEE NOTES

New A.S.T.M. Technical Committee to Be Formed on Sampling and Analysis of Atmospheric Pollution

COGNIZANT of the widespread interest in air pollution, and responsive to the expressions of many authorities in this field that the Society could render a real service along technical lines, the A.S.T.M. Board of Directors has authorized the formation of a new technical Committee on Sampling and Analysis of Atmospheric Pollution. Dr. Louis C. McCabe, chief of Air and Stream Pollution, U. S. Bureau of Mines, an outstanding authority in this field, has accepted the temporary chairmanship of the new committee.

In authorizing the committee, the Board stated that the Society will not consider the problems of specifying limitation of pollution, nor such other related matters as biological and health problems.

It is realized that the new committee will have some great problems in developing analytical and sampling test methods as standards, but the situation at present is so involved and to some extent chaotic that the work should be useful to all the interests involved—industry, municipal and state governments, the Federal government, and others. While much work has already been done on the various instrumentation angles, there continues a need for additional new and improved instruments. Much research is already under way in this field directed toward the development of instruments by which a single or a few contaminants will be measured. Studies are continuing in various channels on contaminants to be measured which will offer a true index of the nature and extent of pollution in an atmosphere.

For those who are interested, there is

much in the history of various lands concerning air pollution. For example, it is quite definite that this problem dates back at least to the 13th century when Queen Eleanor, wife of Henry the Third, is reported to have left the town of Nottingham, England, because of the smoke from "sea coals." There was considerable legislation, even to the extent of barring the use of coal in London.

Recently, the smog situation in leading industrial centers, coupled with incidents such as the deaths at Donora, attributed to air pollution, is responsible for the present concerted interest in abatement.

Not only is air pollution important from the health standpoint, but it is a very serious economic problem. According to recent estimates, great sums

of money are spent annually on equipment and other means to control air contaminants. Expenditures for modernizing plants (for abatement) cost the entire country about \$50,000,000 during 1948.

Whether one considers the cost of modernizing plants or the estimated extra laundry bills and damage to fabrics, or loss of heating efficiency or damage to crops, or lawsuits, for example from the Donora situation, the figures—even the conservative ones—are in the millions of dollars.

Many aspects of the problem are beyond the scope of the Society. In setting up the proposed committee made up as it will be, of representatives of industry, government agencies, and others concerned, it is hoped that through the time-tested procedure of developing acceptable standard tests and analytical methods, agreement can be reached on this one very important technical phase of sampling and analysis.

X-ray Card Index File Now Being Critically Reviewed

In 1945 the Joint Committee on Chemical Analysis by X-ray Diffraction Methods of the A.S.T.M. A.S.X.R.E.D. (now Am. Crystallographic Assn.), and the British Institute of Physics expressed a need for critical reviewing of data in its card index file of diffraction patterns, for the purpose of eliminating incorrect and duplicate patterns and providing additional patterns. The cooperation of the National Bureau of Standards was solicited in a program to this end. The necessary equipment for preparing diffraction pattern standards of high pre-

cision was acquired by the Bureau, and in 1949 a Research Fellowship was set up under the sponsorship of the A.S.T.M. to further the project. The direction of the work was vested in a special group comprising W. L. Fink of the Aluminum Company of America, L. L. Wyman of General Electric Company, W. P. Davey of The Pennsylvania State College, and L. K. Frevel of Dow Chemical Company. The work is being done under the direct supervision of H. F. McMurdie, Chief of the Constitution and Microstructure Section of the Division of Mineral Products

at the Bureau. H. E. Swanson is in charge of X-ray diffraction standards, and the incumbent of the A.S.T.M. fellowship is Miss Eleanor Tatge.

The apparatus used for the standards work is a modified Philips spectrometer with a effective recording arc of 160 deg. A Machlett X-ray tube furnishes a focal spot of approximately 1.0 by 0.2 mm. The instrument is calibrated with pure materials of well-known unit cells such as tungsten, molybdenum, silver, platinum, gold, silicon, aluminum, copper, sodium chloride, calcite, and diamond. Temperature is controlled for all patterns at 25 ± 2 C. The accuracy of the spacing measurements is within ± 0.02 deg. θ ($\frac{1}{2}$ diffraction angle). Intensity measurements are not made on the interplanar spacing chart but from a special chart made with a randomly oriented specimen in order that the resulting data may be more comparable with those of other varying techniques. Effort is made to obtain specimens of high purity, which are checked when necessary by chemical and spectroscopic analyses at the Bureau of Standards. The material is examined under the petrographic microscope to check phase purity, and the index of refraction is obtained where practical as a further check on composition. An oven is available for drying materials, and a dry box, designed and constructed at the Bureau is used when dry air or nitrogen atmosphere is necessary in preparing samples.

The spectrometer data are recorded automatically on charts from which interplanar spacings are derived directly by means of tables prepared at the Bureau in 1948 and now in the process of publication. The resulting patterns, accompanied by the intensity measurements, are set up in a table together with all previously recorded patterns obtainable. Where the patterns of the A.S.T.M. file are derived from published sources, the original publication is obtained and checked; otherwise the data on the file cards are evaluated as completely as possible. Where it is practical, the diffraction maxima are indexed and the unit cell size determined and compared with earlier work. In accordance with the instructions of the Joint Committee, the work of the Fellowship has been limited at present to the consideration of patterns duplicated in the diffraction file.

Detailed reports on each substance are submitted at monthly intervals to the Joint Committee members. The reports present criticism of inaccuracies of previous patterns; evaluation of differences in patterns due to radiation, temperature, units of measurement, and

types of apparatus employed; complete literature references to the patterns considered; and tables comparing interplanar spacings, intensity measurements, and unit cell dimensions. Plans are under way to publish the material contained in these reports from time to time. At present two papers are in preparation for the *Journal of Research* of the National Bureau of Standards.

The first paper will include a description of the apparatus and procedure used in the making of standard patterns along with several patterns of materials available as samples of high chemical purity, the second will include the

material presented in the first of the reports to the Joint Committee on duplicates in the A.S.T.M. file.

To date standard patterns have been prepared for the substances listed in Table I and reports submitted to the Joint Committee. In Table I the substances are listed with the numbers of the A.S.T.M. diffraction pattern file cards upon which they appear.

A report on high-temperature cristobalite was made to the Joint Committee, although no pattern was prepared. It was recommended that a pattern published by Barth and Posnjak be adopted as a standard pattern.

TABLE I.—LIST OF SUBSTANCES IN X-RAY DIFFRACTION CARD INDEX FILE REVIEWED BY JOINT COMMITTEE FELLOWSHIP AT NATIONAL BUREAU OF STANDARDS.

Substance	Card Number		
	Obsolete Old Edition	Revised 1950 Edition	
		File Combined in Hanawalt Groups	File in Simple Numeric Sequence ^a
Aluminum (Al).....	3049 3060 3061 II-2503 1661	3241 3224 3225 3243 1588	1-1176 1-1179 1-1180 2-1109 1-0674
Ammonium chloride (NH ₄ Cl).....	2539 2569 2570	2754 2761 2762	1-1037 1-1043 1-1044
Arsenic trioxide (As ₂ O ₃).....	1820 II-4177	1778 3975	1-0754 2-1451
Barium fluoride (BaF ₂).....	1346 II-2633 2687	1311 3305 2855	1-0533 2-1157 1-1079
Calcium hydroxide (Ca(OH) ₂).....	II-2043 II-2049 II-2050	2911 2856 2857	2-0867 2-0868 2-0969
Calcium oxide (CaO).....	2989 II-2441	3183 3140	1-1160 2-1088
Ceric oxide (CeO ₂).....	1927 II-3085	1936 3675	1-0800 2-1306
Copper (Cu).....	3311 3312 II-2828 2193	3500 3504 3499 2212	1-1241 1-1242 2-1225 1-0899
Lithium chloride (LiCl).....	2194 II-1364	2214 2096	1-0900 2-0640
Lithium chloride monohydrate (LiCl·H ₂ O).....	2602 II-1870	2763 2767	1-1052 2-0898
Lithium fluoride (LiF).....	3407 3408 II-2511 3286	3558 3559 3226 3424	1-1269 1-1270 2-1111 1-1235
Magnesium oxide (MgO).....	II-2798 II-3816	3418 3850	2-1207 2-1395
Mercuric iodide (HgI ₂).....	1362 3204 945	1312 3336 0959	1-0542 1-1217 1-0420
Mercurous chloride (Hg ₂ Cl ₂).....	1869 II-1222	1792 1921	1-0768 2-0560
Potassium bromide (KBr).....	1705 1676	1664 1661	1-0695 1-0680
Potassium chloride (KCl).....	1904 1911	1914 1913	1-0786 1-0790
Potassium cyanide (KCN).....	1711 II-1064	1667 1666	1-0700 2-0482
Potassium fluoride (KF).....	2614 2656 II-2042	2829 2830 2901	1-1056 1-1069 2-0966
Potassium iodide (KI).....	1392 1393	1299 1302	1-0554 1-0555
Silicon dioxide (α-cristobalite) (SiO ₂).....	1010 II-612	1004 1005	1-0438 2-0285
Sodium cyanide (NaCN).....	2234 II-1530	2346 2348	1-0913 2-0739
Sodium fluoride (NaF).....	3062 II-2522	3231 3233	1-1181 2-1115
Thorium oxide (ThO ₂).....	1769 II-2995	1773 3634	1-0731 2-1278
Titanium dioxide (anatase) (TiO ₂).....	1406 II-876 II-911	1324 1323 1390	1-0562 2-0387 2-0406

^a The numerals "1-" and "2-" preceding the card number indicate the revised original and revised second supplementary sets, respectively.

Data on Strength of Metals at High Temperature

THE A.S.T.M.-A.S.M.E. Joint Committee on the Effect of Temperature on the Properties of Metals has been requested by the Boiler Code Committee of The American Society of Mechanical Engineers, the Prime Movers Committee of the Edison Electric Institute, the Committee on Power Generation of the Association of Edison Illuminating Companies, and the Air Force to compile high-temperature data on various metals and alloys used at elevated temperatures. The Civil Aeronautics Administration of the Department of Commerce, the Research and Development Board, and the Aircraft Industries Association have also indicated their desire for a compilation of this type.

In 1938 the Joint Committee made a compilation of data then available, which was issued as a Data Book by the sponsor societies, but which is now out of print. During the past 12 years, much additional information has accumulated. The current requests for an up-to-date compilation have resulted in a decision by the Joint Committee to proceed with a new survey, the results of which will be published by the sponsor societies. As in the 1938 Compilation, the individual contributors will be identified only by number.

While the Joint Committee intends eventually to survey the high-temperature properties of all types of metals used for elevated temperature applications, it has adopted the policy of "limited objectives" and it is planned to divide the metals into several groups. Information on these materials can then be issued as soon as it becomes available instead of waiting several years for the compilation of a large book covering the materials. It is hoped that this approach will make the task less burdensome both for those supplying the data and for those who will compile and issue the information.

It has been agreed that the initial effort will be confined to the cast and wrought austenitic-chromium-nickel alloys. Producers of these are being asked to support the committee with any original information which they may have on chromium-nickel stainless steels such as those listed below. Data compiled from the literature are not solicited at this time.

18-8	25-12
18-8 Ti	25-20
18-8 Cb	25-20 Si
18-8 Mo	25-20 Cb
18-8 Mo-Cb	15-35

Blank form sheets are being sent to

the producers in the hope that they will wish to contribute to this undertaking. Additional forms may be obtained from H. C. Cross, Battelle Memorial Institute, Columbus, Ohio, to whom the completed forms should be returned. The front side of the form is, in effect, a "short form" designed for properties and information which the producers have probably already derived from their creep and rupture tests; the reverse side is a "long form" and requests more detailed creep and rupture data, desired by some engineers. For each material, it is essential that the short form be completed, in so far as it can be, but it is hoped that recipients will see fit to complete the reverse side as well. Data supplied for the 1938 survey need not be re-submitted.

The committee will be able to carry out this worth-while survey of data successfully only with the cooperation of those who are in a position to supply the needed data.

Progress Being Made in Acoustical Materials Standardization

COMMITTEE C-20 on Acoustical Materials held a meeting at A.S.T.M. Headquarters on May 23 following the meeting of all of its subcommittees. Subcommittee I on Sound Absorption discussed small-scale test methods which might be considered, including the box and the tube methods. It was agreed that the box method would be written up for information purposes initially and that the tube method would receive later consideration. Round robin tests on one sample are being made in reverberation chambers, with extensive research also being conducted by the Acoustical Society of America and Armour Research Foundation. Much discussion took place in the meeting of Subcommittee II on Fire Resistance concerning its scope of activities. It was the consensus that initially the subcommittee should survey all existing fire test methods which might be applicable to acoustical materials rather than to inaugurate a new fire test procedure. Much interest was shown in respect to the tunnel test now being proposed by Committee E-5, although there is a definite lack of data on this type of test as pertaining to acoustical materials. The subcommittee will stand by for the time being pending further activity by Committee E-5 as well as other committees in the development of the tunnel test equipment. In the meeting of Subcommittee IV on Application, it was pointed out that 70 per cent of the acoustical material used is applied by adhesive meth-

ods. Therefore, it was felt that testing procedure on this type of application be given first consideration. Many variables are involved in the use of adhesives, and research of an empirical nature is necessary to establish significant data for the formulation of standards. Subcommittee V on Basic Physical Properties discussed the light reflectance measurement method (Baumgartner Sphere) which will be written up for subcommittee review. Strength properties which will be given consideration include hardness, thumb and finger indentation, toughness, transverse, friability, and surface abrasion. It was agreed that the guarded hot plate test method, A.S.T.M. Designation C 177, would be a satisfactory method for determining thermal conductivity of acoustical materials. The guarded hot box method, A.S.T.M. Designation C 236, is also adaptable for built-up structures. Three task groups have been organized covering thermal conductivity, flow resistance, and strength properties.

It was the consensus that it would be appropriate to hold meetings of the committee at the time of the meeting of the Acoustical Society of America, and the next meeting was set with this in mind tentatively for a two-day meeting to be held immediately prior to the meeting of the Acoustical Soc. in Cambridge, Mass., on November 9. The present officers were re-elected for the present ensuing two-year term.

Expansion of Activities of the Concrete Pipe Industry

FOR YEARS the American Concrete Pipe Association has been the only association in the concrete pipe field representing the manufacturers. It concerned itself mainly with concrete sewer and culvert and concrete irrigation pipe and drain tile. During the past year two new associations have been formed, both affiliated with the older association. The American Concrete Pressure Pipe Assn. has been organized as a trade association to promote the interests of the concrete pressure pipe industry. More recently a group of manufacturers of concrete irrigation pipe and concrete drain tile formed the American Concrete Agricultural Pipe Assn. to promote more directly their interests in this field. The three national concrete pipe associations will coordinate their activities as members of a joint association known as Concrete Pipe Assns., Inc. H. F. Peckworth will act as Managing Director of all three organizations with headquarters in Chicago, Ill.

Gypsum Committee Recommends Extensive Revisions at Meeting

COMMITTEE C-11 on Gypsum met at the National Bureau of Standards, Washington, D. C., on May 12. Most of the business transacted at this meeting was related to the presentation, discussion, and the final acceptance of long pending revisions of the several standards. These revisions are being made in the Standard Definitions of Terms Relating to Gypsum (C 11), Standard Specifications for Gypsum (C 22), Standard Methods of Testing Gypsum and Gypsum Products (C 26), Standard Specifications for Gypsum Plasters (C 28), Standard Specifications for Gypsum Wallboard (C 36), Standard Specifications for Gypsum Lath (C 37), Standard Specifications for Gypsum Molding Plaster (C 59), Standard Specifications for Keene's-Cement (C 61), and Standard Specifications for Gypsum Shearing Board (C 79). One of the principal revisions is that of substituting a compressive strength requirement in place of tensile strength.

A report on the testing of lightweight aggregates was distributed for further study by the chairman of the Subcommittee on Testing Methods. A special section was authorized under Subcommittee I to review this report. Further revisions in the chemical analysis procedures in Standard Methods of Testing Gypsum and Gypsum Products (C 26) have been proposed, but further review is contemplated.

A reorganization of the committee was approved which will streamline the work through the reduction in subcommittees from four to two. The two subcommittees will be known as Subcommittee I on Plasters with H. N. Huntzicker as chairman and Subcommittee II on Structural Products with N. D. Mitchel as chairman. The election of officers resulted in Dr. L. S. Wells being elected as Chairman, H. F. Gardner as Vice-Chairman, and L. H. Yeager as Secretary.

Glass Committee Meets in New York City

COMMITTEE C-14 on Glass and Glass Products held its annual meeting at the Hotel Statler, New York City, on April 26. A luncheon meeting was held during the program of The American Ceramic Society with 24 members present. Of interest to the

members, in the several subcommittee reports presented, was the recommendation that a proposed method of test for resistance of glass to surface abrasion be considered by Subcommittee VIII on Flat Glass. Action was taken to form a new section for the purpose of studying this proposed method, with C. H. Hahner as the chairman. The Subcommittee on Chemical Analysis is planning to consider a new procedure for the routine determination of boric oxide in glass. A motion was accepted for recommending the immediate adoption of revisions to three test methods on glass containers, namely, hydrostatic pressure tests (C 147), polariscopic examination (C 148), and thermal shock test (C 149). A suggestion that a new subcommittee be formed on control tests for glass manufacture was referred to the Advisory Subcommittee for consideration.

The following officers were elected for the ensuing two-year term: L. G. Ghering, Chairman, Lee Devol, Vice-Chairman, and F. V. Tooley, Secretary.

Sustaining Members

WE ARE pleased to announce the assumption of sustaining memberships by two organizations active in the Society. These have been taken out recently by Republic Steel Corp. and Proctor & Gamble Co.

The Republic organization has been affiliated with the Society since 1914 through a company membership, and a number of individuals in the corporation are also members and have been active in the work of the Society, including Earl C. Smith, Chief Metallurgist of the Corporation, Cleveland, and J. S. Adelson, Chief Metallurgist of the Steel and Tubes Division, and others. The organization has been particularly active in the work of Committee A-1 on Steel but recently has reviewed its committee affiliations and will take part in the work of a number of other groups.

Proctor & Gamble Co., through its General Engineering Division, Ivorydale, Ohio, has held company membership since 1929, its interest in the Society having been largely in the chemical field, notably in soaps and detergents. It also has had representation on Committee D-13 on Textile Materials.

Some of the advantages of a sustaining membership in the Society have been noted from time to time, one of which includes receipt of a complete set of all publications issued by the Society and an extra complete set of the Book of Standards on request. All the

privileges of a company membership also apply to sustaining members. Through the annual dues of \$150 the sustaining members are contributing an important portion of the Society's income from dues. Further information concerning this class will be sent to any organization interested. At the present time there are about 220 sustaining members.

1951 National Meetings in Atlantic City and Cincinnati

DECISION has been reached by the Board of Directors to return to Atlantic City for the 1951 Annual Meeting, using Chalfonte-Haddon Hall as convention headquarters. This will be the Fifty-fourth Meeting, during the week of June 18 to 22, inclusive.

The 1951 Spring Meeting and A.S.T.M. Committee Week will be held in Cincinnati during the week March 5 through 9. Reservations have been made at the Netherlands-Plaza Hotel.

Calendar of Society Meetings

- AMERICAN CHEMICAL SOCIETY—118th National Meeting, September 3-8, Chicago, Ill.
- INSTRUMENT SOCIETY OF AMERICA—Conference and Exhibit, September 11-15, Buffalo, Auditorium, Buffalo, N. Y.
- NATIONAL PETROLEUM ASSOCIATION—September 13-15, Hotel Traymore, Atlantic City, N. J.
- INSTRUMENT SOCIETY OF AMERICA—5th National Instrument Conference and Exhibit, September 18-22, Memorial Auditorium, Buffalo, N. Y.
- SOCIETY OF PLASTICS INDUSTRY—Annual National Conference, October 18-20, New Ocean House, Swampscott, Mass.
- AMERICAN SOCIETY FOR METALS—32nd National Metal Congress and Exposition, October 23-27, International Amphitheatre, Chicago, Ill.
- NATIONAL FOUNDRY ASSOCIATION—Annual Meeting, November 8-10, Edgewater Beach Hotel, Chicago, Ill.
- AMERICAN PETROLEUM INSTITUTE—Annual Meeting, November 13-16, Biltmore and Ambassador Hotels, Los Angeles, Calif.
- NATIONAL PAINT, VARNISH & LACQUER ASSN.—November 15-18, Fairmont Hotel, San Francisco, Calif.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Annual Meeting, November 27-December 1, Hotel Statler, New York, N. Y.
- AMERICAN INSTITUTE OF CHEMICAL ENGINEERS—Annual Meeting, December 3-6, Columbus, Ohio.
- SOCIETY OF PLASTICS ENGINEERS, INC.—7th Annual National Technical Conference, January 18-20, 1951, Hotel Statler, New York, N. Y.

PERSONALS . . .

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.

At the Fifty-second Annual Meeting of The American Ceramic Society in New York City, at which there was an all-time attendance record of 2041, a number of A.S.T.M. members and committee members were in the news. The retiring President, **H. M. Kraner**, Bethlehem Steel Co., is active in Committee C-8 on Refractories. New officers of A.C.S., all affiliated with A.S.T.M. in some capacity, are as follows: **J. W. Hepplewhite** of Edwin M. Knowles China Co., President; **Aaron K. Lyle** of Hartford-Empire Co., Vice-President; **Howard R. Lillie** of Corning Glass Works, President-Elect; and **Hewitt Wilson** and **T. A. Klinefelter**, both of the U. S. Bureau of Mines, Vice-Presidents. Other Ceramic Society men, many of whom serve on A.S.T.M. technical committees—for example C-8 on Refractories, C-14 on Glass, C-21 on Ceramic Whitewares, and C-22 on Porcelain Enamel—and are likewise officers of respective divisions of A.C.S., include the following: **E. C. Henry**, **P. G. Herold**, **H. H. Holscher**, **E. E. Howe**, **C. E. Leberknight**, **K. C. Lyon**, **G. H. McIntyre**, **F. A. Petersen**, **Stuart M. Phelps**, **Ralston Russell, Jr.**, **Karl Schwartzwalder**, **R. B. Sosman**, **G. H. Spencer-Strong**, **F. V. Tooley**, **Robert Twells**.

A number of A.S.T.M. members and committee men are to serve the Engineering Society of Detroit as officers during the coming year. **J. L. McCloud**, Ford Motor Co., is to be First Vice-President; **F. P. Zimmerli**, Barnes-Gibson-Raymond Division, Associated Spring Corp., is Second Vice-President; **George W. McCordic**, Huron Clinton Metropolitan Authority, is Secretary; and **Earl Bartholomew**, Ethyl Corp., has been appointed a Board member to serve for three years.

Leslie W. Ball, Chief of the Mechanical Evaluation Division, Naval Ordnance Laboratory, White Oak, Md., since 1946, has been appointed Chief of the Physics Research Department at the Laboratory. Widely known for his contributions to the field of radiography and for his many articles pertinent to nondestructive testing techniques, Dr. Ball is a member of A.S.T.M.'s Committee E-7 on Non-Destructive Testing, rendering active service on several of its subgroups, and is currently a member of the Washington (D. C.) District Council of the Society.

James R. Beam, formerly Technical Director, Universal-Rundle Corp., New Castle, Pa., is now associated with the Trenton Potteries Co., Trenton, N. J., in a similar capacity.

William T. Bean, Jr., has been appointed Director of the recently formed Technical Service Center of Industrial Electronics, Inc., Detroit, Mich. An internationally known authority on experimental stress analysis, Mr. Bean has been much in demand for the past year as a lecturer and consultant on instrumentation and application of strain measuring devices. He has spoken at several A.S.T.M. district meetings.

Rolf O. Breuer, formerly Materials Engineer, U. S. Dept. of the Navy, Terminal Island Naval Shipyard, San Pedro, Calif., is now associated with the Phelps Dodge Copper Products Corp., Los Angeles, Calif.

Harold L. Cahn is now on the technical staff of the U. S. Stoneware Co., Akron, Ohio. He was previously with the Inter-Chemical Corp. at Wooster.

Henry J. Cohn, formerly Textile Chemist, Silcot Mfg. Co., Inc., New York City, is now associated with the Cedar Cliff Silk Co., Inc., of the same city in a similar capacity.

Thomas H. Daugherty, formerly Assistant Director of Research for Calgon, Inc., Pittsburgh, has been named Director of Research, succeeding **Dr. Everett P. Partridge**, recently appointed Director of Hall Laboratories, Inc., an associated firm in the Hagan Corporation group. Dr. Daugherty, now in immediate charge of Calgon research and development projects, has been active in the work of A.S.T.M. Committee D-19 on Industrial Water for several years. As noted in the May, 1950, BULLETIN, Dr. Partridge is actively directing Hall Laboratories, with the retirement of **Ralph E. Hall**.

Philip C. Faith is now Chief Equipment Inspector for Fifth Avenue Coach Co. and New York City Omnibus Corp., Belleville, N. J.

Karl L. Fetters is one of two recently appointed assistants to A. S. Glossbrenner, Vice-President in Charge of Operations of The Youngstown Sheet and Tube Co., Youngstown, Ohio. Dr. Fetters, who was formerly Special Metallurgical Engineer, is a member of Committee E-11 on Quality Control of Materials, being the current Chairman of the subgroup on Numerical Requirements in Standards.

James A. Harding has been appointed Factory Manager for Modernair Corp., Oakland, Calif. He was formerly Project Engineer with Schlage Lock Co., San Francisco, and Manufacturing Engineer with Marchant Calculating Machine Co., Oakland. His previous Eastern connections included positions with similar re-

sponsibilities with Simplex Valve & Meter Co. and Brown Instrument Co., both of Philadelphia, and the Burroughs Adding Machine Co., in Detroit, Mich.

T. R. Higgins, formerly Chief Engineer, is now Director of Engineering, American Institute of Steel Construction, New York City.

John C. Hostetter, formerly President, Mississippi Glass Co., St. Louis, Mo., who had a heart attack in December, has relinquished a number of his administrative responsibilities in the company and is now serving as consultant. Dr. Hostetter has been Chairman of the A.S.T.M. St. Louis District Council, and is relieved of this responsibility with the election of a new Chairman, **S. Blake Roberts**, as announced elsewhere in this BULLETIN. Dr. Hostetter plans to spend a good deal of his time in New York City where he is making his home but to winter in Florida.

Louis Albert Lachman, formerly Director of Engineering, New London Junior College, New London, Conn., is now Design Engineer, Harry W. Faerber Corp., Springdale, Conn.

George O. Linberg, formerly Sales Manager, Monsanto Chemical Co., Boston, Mass., has been appointed Director and Vice-President in Charge of Sales, Belle Chemical Co., Reading, Pa.

Pauline Beery Mack, Director, Ellen H. Richards Institute, The Pennsylvania State College, is the 1950 recipient of the Francis P. Garvan Gold Medal of the American Chemical Society. The award specifically honored Dr. Mack for her work in the calcium chemistry of bone density, her medal address on the subject being delivered at the A.C.S. Detroit Meeting in April before the Division of Physical and Inorganic Chemistry. Recognized as one of the outstanding women scientists of today, Dr. Mack has worked personally on the development of methodology for measuring calcium retention in bones for 23 years. Her work at the Institute also concerns research problems related to application of chemistry to food, clothing, and shelter. Affiliated with A.S.T.M. since 1931, Dr. Mack has rendered active service in Committees D-12 on Soaps and D-13 on Textile Materials.

Carl S. Miner, Director of Miner Laboratories, Chicago, has been selected to receive the 1950 Honor Scroll Award of the Chicago chapter of the American Institute of Chemists, the award being made in recognition of his abilities as a chemist, and for his efforts in advancing the professional interests of chemists, particularly in awakening and guiding professional attitudes in younger chemists.

Howard K. Nason, formerly Director, Central Research Dept., Monsanto Chemical Co., Dayton, Ohio, has been appointed Assistant to the Vice-President, Research and Development, with headquarters in St. Louis. A Director of A.S.T.M., Mr. Nason has been very active in technical committee work, notably Committee D-20 on Plastics.

Henry B. Oatley, a long-time member of A.S.T.M. and Vice-Chairman of Committee A-1 on Steel, had an active time

during the 1950 Commencement Exercises at the University of Vermont, of which he is an alumnus in the Class of 1900. He is president of this class and a former president of the University Alumni Council and a former trustee. At the exercises he was honored by receiving the honorary degree of doctor of engineering. He has an active family, and the feature picture on the first page of the Burlington, Vt., *Free Press* of June 12, shows him with three of his daughters.

L. A. O'Leary, Head, Chemical Engineering and Research Dept., W. P. Fuller and Co., South San Francisco, and newly elected Chairman of the A.S.T.M. Northern California District Council, is serving as chairman of the Technical Program Committee for the "Federation Day" program of the Federation of Paint & Varnish Production Clubs on November 17-18 in San Francisco in conjunction with the annual convention of the National Paint, Varnish and Lacquer Association. **S. L. Davidson**, Chief Chemist, National Lead Co., San Francisco, and a newly elected Councilor of A.S.T.M.'s Northern California District, heads the General Committee on Arrangements for the Federation meetings scheduled for the afternoon of November 17 and the morning of November 18.

Frank E. Richart, A.S.T.M. Vice-President Research Professor of Engineering Materials, University of Illinois, was honored with the first Alfred E. Lindau Award of the American Concrete Institute "for his years of labor toward the improvement of reinforced concrete design practice."

A. O. Schaefer, formerly Executive Metallurgical Engineer, The Midvale Co., Philadelphia, has been elected Vice-President in Charge of Engineering and Manufacturing. He has been affiliated with the company since 1922, following his graduation at the University of Pennsylvania. Very active in A.S.T.M., he has headed the important Subcommittee on Steel Forgings in Committee A-1 on Steel, is Chairman of the Philadelphia District, and has participated in other A.S.T.M. work.

Orville K. Schmied, Technical Director, Research and Sales Div., Cochran Foil Co., Louisville, Ky., and **Malcolm L. Taylor**, Technical Director, Union Bag and Paper Corp., Savannah, Ga., were among 25 distinguished University of Louisville alumni who were honored by presentation of a bronze medal at the twenty-fifth anniversary exercises of the University's Speed Scientific School.

Richard Schneidewind, Professor of Metallurgical Engineering at the University of Michigan, has been awarded the McFadden Gold Medal of the American Foundrymen's Society "for his valuable contribution to the malleable iron industry in connection with the graphitization of white cast iron, and for his many contributions to the society and the metal castings industry."

Lawrence H. Seabright, formerly Methods Engineer, Kellogg Switchboard and Supply Co., Chicago, is now Chemical Engineer, Vulcan Stamping & Mfg. Co., Bellwood, Ill.

Allen Thomas Simpson has accepted a position as Maintenance Engineer, Coulls Somerville Wilkie, Ltd., Dunedin, New Zealand. He was previously Sales Engineer with James J. Niven & Co., Ltd., of the same city.

Oliver Smalley, President, Meehanite Metal Corp., New Rochelle, N. Y., was presented with a gold medal plaque at the 24th annual convention of the manufacturers of Meehanite castings in the United States. Mr. Smalley has guided his company's activities for the past 25 years.

Roman Smoluchowski, who will become Professor of Metallurgical Engineering at Carnegie Institute of Technology, Pittsburgh, in September, delivered a lecture on "Order-Disorder Phenomena in Ferromagnetic Materials" at the International Conference on Magnetism held this month at Grenoble, France, the first conference of its kind since before the war. Dr.

Smoluchowski represents the Institute on A.S.T.M. Committee E-7 on Non-Destructive Testing.

Carl E. Swartz, Division Engineer, Kellogg Corp., New York City, has been named Chairman, Metals Research Department, Armour Research Foundation of Illinois Institute of Technology, Chicago. He has been in charge of materials research and development at the Kellogg applied physics laboratory in Silver Spring, Md. He succeeds **W. E. Mahin**, recently promoted from Chairman of Metals Research to Director of Research of the Foundation.

Victor F. Volk is now Editor for *Electric Wire*, Brooklyn, N. Y.

Eric Weyl, textile engineering consultant, formerly of Manchester, N. H., has moved his office to Charlotte, N. C. Mr. Weyl, a specialist in cotton spinning, serves as regular consultant to many textile mills.

NEW MEMBERS...

The following 87 members were elected from April 21, 1950, to June 10, 1950, making the total membership 6770... Welcome to A.S.T.M.

Note—Names are arranged alphabetically—company members first, then individuals

Chicago District

FRY ROOFING CO., **LLOYD A. W. H. Barthel**, Vice-President, 5818 Archer Rd., Summit, Ill.

RAULAND CORP., **THE**, 4245 N. Knox Ave., Chicago 41, Ill.

SIMONIZ CO., **THE**, **Paul E. Wenaas**, Chief Chemist, 2100 Indiana Ave., Chicago 16, Ill.

BROWN, VICTOR, Director of Metallurgy and Research, Kropp Forge Co., 5301 W. Roosevelt Rd., Chicago 50, Ill.

CSANYI, LADIS H., Professor of Civil Engineering, Iowa State College, Ames, Iowa. For mail: 427 N. Franklin Ave., Ames, Iowa.

DAVIDSON, DONALD THOMAS, Assistant Professor of Civil Engineering, Iowa State College, Civil Engineering Dept., Ames, Iowa.

FREEMAN, RAYMOND B., Engineer, Commonwealth-Edison Co., 72 W. Adams, Chicago, Ill. For mail: 4131 Linden Ave., Western Springs, Ill.

GUSHARD, L. N., Viking Pump Co., Cedar Falls, Iowa. For mail: 1901 Main St., Cedar Falls, Iowa.

HART, HENRY A., President, Henry A. Hart and Associates, 23 W. Hubbard St., Chicago 10, Ill.

KENDRICK, J. W., Product Engineer, Met-L-Wood Corp., 6755 W. Sixty-fifth St., Chicago 38, Ill.

McDOWELL, ELMER H., Graduate Student, Illinois Institute of Technology, Chicago 16, Ill. For mail: 9406 S. St. Lawrence Ave., Chicago 19, Ill. [J]*

ROSNER, ARNOLD STANLEY, Instructor, Structural Design, Institute of Design, Illinois Institute of Technology; and Structural Engineer, Max Rosner and Associates, 201 N. Wells St., Chicago 6, Ill.

WINKELMANN, HERBERT A., Technical Director, Dryden Rubber Division, Sheller Manufacturing Corp., 1014 S. Kildare Ave., Chicago, Ill. For mail: 419 Oakdale Ave., Chicago 14, Ill.

Cleveland District

AKERS, RUDOLPH H., Metallurgical Engineer, Chandler Products Corp., 1491 Chardon Rd., Cleveland 17, Ohio.

JORDON, ELWYN L., Chief Specifications Writer, J. Gordon Turnbull, Inc., 2630 Chester Ave., Cleveland, Ohio. For mail: Box 897, Richland, Wash.

Detroit District

WAGNER BROTHERS, INC., **John E. Hunt**, Chief Chemist, 400 Midland Ave., Detroit 3, Mich.

KEGG, R. R., Chief Chemical Engineer, Kimble Glass Division of Owens-Illinois Glass Co., Box 1035, Toledo 1, Ohio. For mail: 5126 Ottawa River Rd., Toledo, Ohio.

MILLER, C. J., Chief Metallurgist, Kaiser-Frazer Corp., Willow Run, Mich.

STERNBERGER, W. V., Motor Products Corp., 11801 Mack Ave., Detroit 14, Mich.

New England District

BLAIR-VERMONT PLYWOOD CO., **W. D. Eisenhauer**, Technical Director, Hancock, Vt.

CASE BROTHERS, INC., **Robert Case Dennison**, Vice-President, P. O. Drawer 831, Manchester Conn.

DAVIS, STAFFORD E., Tool Designer, Ark-Les Switch Corp., 50 Water St., Watertown, Mass.

DEVOL, LEE, Industrial Research, 54 Castlewood Rd., West Hartford 7, Conn.

POLYCHROME, **DEMITRIOS AREMISTOS**, Assistant Professor, Building Engineering and Construction, Massachusetts Institute of Technology, Room 5-229, Cambridge, 39, Mass.

SHAPIRO, LEONARD, Research Director, Synthron, Inc., Ashton, R. I.

New York District

CONMAR PRODUCTS CORP., **R. A. Gobeil**, Textile Engineer, 140 Thomas St., Newark 1, N. J.

CORNELIUS PRODUCTS CO., **Fred W. Rau**, Chief Chemist, 386 Fourth Ave., New York 16, N. Y.

LEGGE CO., INC., **WALTER G.**, **Walter G. Legge**, President, 101 Park Ave., New York 17, N. Y.

ANDERSON, ARTHUR R., Consulting Engineer, 110 Woodbury Ave., Springdale, Conn.

ARCHER, R. S., Metallurgical Engineer, Cli-

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max Molybdenum Co., 500 Fifth Ave., New York 18, N. Y.
CUTLER, LLOYD R., Miracle Adhesives Corp., 214 E. Fifty-third St., New York 22, N. Y.
FARKAS, GEORGE B., Mechanical Engineer, Hydrocarbon Research, Inc., 115 Broadway, New York 6, N. Y.
FLEMING, J. W., Manager of Technical Information Center, Philips Laboratories, Inc., Irvington-on-Hudson, N. Y.
HARTSHORNE, EDWARD, Assistant Director of Research and Development, Winchester Repeating Arms Co., New Haven 4, Conn.
LOIACONA, J. M., Acting Chief Metallurgical Engineer, Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.
MANNWEILER, GORDON BANNATYNE, Research Engineer, The Eastern Malleable Iron Co., 112 Bridge St., Naugatuck, Conn.
NEW YORK BUILDING CODE COMMISSION, 1740 Broadway, New York 19, N. Y.
U. S. ATOMIC ENERGY COMMISSION, John E. Donovan, Assistant to Director, Box 150, New Brunswick, N. J.
VAN DYCK, EMILE J. E., Manager, Madagascar Graphite and Mica Co., 115 W. Twenty-third St., New York 11, N. Y.
VAN RAALTE, LEOPOLD, Secretary and Treasurer, Van-Man, Inc., 98-100 S. Fourth St., Brooklyn 11, N. Y.
WINSLOW, EARL HOLDEN, Research Associate, General Electric Co., Research Lab., Schenectady, N. Y. For mail: 2051 Coolidge Pl., Schenectady S. N. Y.

Northern California District

CALIFORNIA, UNIVERSITY OF, ENGINEERING MATERIALS LABORATORY, Berkeley 4, Calif.

Ohio Valley District

REX MANUFACTURING CO., INC., J. N. Anderson, Director of Laboratory, 1500 Western Ave., Connerville, Ind.
SPINKS CLAY CO., INC., H. C., Charles F. Hanks, Jr., Sales Engineer, 1000 First National Bank Bldg., Cincinnati 2, Ohio.
HATTEN, MAURICE E., Chemical Engineer, Route 2, Delaware, Ohio. [J]

Philadelphia District

BEAM, JAMES R., Technical Director, Trenton Potteries Co., 309 N. Clinton Ave., Trenton, N. J.
CARR, EDWARD J., Laboratory Foreman, Sun Oil Co., Marcus Hook, Pa.
DIEFFENDERFER, DANIEL S., Director of Laboratory, Dixie Cup Co., Twenty-fourth and Dixie Ave., Easton, Pa.
GROVE, H. A., Metallurgical Engineer, Worth Steel Co., Claymont, Del.
PAIGE, HENRY, Metallurgist, Navy Air Material Center, Bldg. 600, Philadelphia Naval Base, Philadelphia, Pa. For mail: 576 E. Ninety-first St., Brooklyn 12, N. Y. [J]
PRINCETON UNIVERSITY LIBRARY, Lawrence Heyl, Associate Librarian, Princeton, N. J.
RADNOR TOWNSHIP, BOARD OF COMMISSIONERS, Everett H. Lord-Wood, Engineer and Building Inspector, 212 E. Lancaster Ave., Wayne, Pa.
SCAFE, E. T., Supervisor, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.
SOHL, CHARLES E., JR., Instructor, York Technical Inst., Duke and College Sts., York, Pa. [J]

Pittsburgh District

APPLEBY, F. E., Manager, Robert W. Hunt Co., 923 Penn Ave., Pittsburgh 22, Pa.
LIEBMAN, A. J., Research Engineer, Dravo Corp., Fifth and Liberty Aves., Pittsburgh, Pa. For mail: 341 McClellan Dr., Pittsburgh 27, Pa.
MARLIN, DONALD H., Metallurgist, Dravo Corp., Neville Island, Pittsburgh 25, Pa.
SONTUM, W. C., Vice-President, Pennsylvania Electric Co., 222 Levergood St., Johnstown, Pa.

St. Louis District

LEONARD WELDING AND MANUFACTURING Co., J. F. O'Neil, Vice-President, 224 Lombard St., St. Louis 2, Mo.
HENDERSON, J. R., Chief Chemist, Consoli-

dated Cement Corp., Fredonia, Kan.
SCHWARZ, ARTHUR F. JR., Architect, Russell, Crowell, Mullgardt & Schwarz, 1620 Chemical Bldg., St. Louis 1, Mo.

Southern California District

LOS ANGELES COUNTY ROAD DEPT., 1636 Eastlake Ave., Los Angeles 33, Calif.

Washington (D. C.) District

VIRGINIA STEEL CO., H. C. Boyd, Chief Engineer, Box 2-A-E, Richmond, Va.
BLAKE, HOWARD E., JR., Manager, Quality Control, Martin & Schwartz, Inc., Salisbury, Md.
CURTISS, JOHN H., Chief, National Applied Mathematics Labs., National Bureau of Standards, Washington 25, D. C.
DUNVILLE, J. G., Executive, Robert M. Dunville and Brothers, Inc., 214 S. Second St., Richmond 19, Va.
FULD, MELVIN, President, Fuld Brothers, Inc., 702-710 S. Wolfe St., Baltimore 31, Md.

Western New York-Ontario District

CANADIAN WOOL CO., LTD., THE, Robert E. Biggin, Production Manager, 701 Metropolitan Bldg., Toronto, Ont., Canada.
FITTINGS LIMITED, V. R. Fulthorpe, Metallurgist, 135 Bruce St., Oshawa, Ont., Canada.
ROCHESTER INSTITUTE OF TECHNOLOGY LIBRARY, 65 Plymouth Ave., South, Rochester 8, N. Y.
SCOTT, R. W., Assistant Engineer, Crouse-Hinds Co., Wolf and Seventh North Sts., Syracuse 1, N. Y.

U. S. and Possessions

MOTOROLA, INC., A. C. Fabris, Jr., Specifications Engineer, 3102 M. Ingleside Dr., Phoenix, Ariz.
JOHNSON, ALBERT G., Assistant Chief Engineer, Omaha Public Power District, Seventeenth and Harney Sts., Omaha 2, Nebr.
NEELEY, A. W., Research Director, Utah Oil Refining Co., Box 898, Salt Lake City 10, Utah.
POOLMAN, ROBERT C., Assistant Professor of Civil Engineering, Civil Engineering Dept., University of Nevada, Box 9025, University Station, Reno, Nev.
REVELL, RUFUS BENJAMIN, Water Chemist, Florida State Hospital, Chattahoochee, Fla. [J]
SOUTHWELL, CHARLES R., JR., Materials Engineer, Municipal Engineering Div., The Panama Canal, Balboa Heights, Canal Zone. For mail: International Boundary Commission, Ft. McIntosh, Laredo, Tex.
WORTH, JAMES G., Chemist, Applied Research Laboratories, 1213 North West Miami Court, Miami 34, Fla.

Other Than U.S. Possessions

EQUIPOS INDUSTRIALES, S. A., Samuel Dultzin, Manager, Balderas No. 96, Mexico, D. F., Mexico.
GENERAL CEMENT CO., Alex Tsatsos, Managing Director, 3 Santarosa St., Athens, Greece.
SOCFIN CO., LTD., I. A. Sibiriakoff, Head Technical Manager, Box 330, Kuala Lumpur, Malaya.
AUSTRALIA, DEPARTMENT OF WORKS AND HOUSING, Box 1381R, G.P.O., Brisbane, Queensland, Australia.
AZIZ, D. Chemist, International Waxes, Ltd., Agincourt, Ont., Canada.
CRAVEN, M. A., Engineer, New Zealand Portland Cement Assn., Box 969, Wellington C.1, New Zealand.
SCHLOEN, JOHN H., Metallurgist, Canadian Copper Refiners, Ltd., Box 489, Place D'Armes, Montreal 1, P. Q., Canada.
TASKIN, FERRUH, Teaching Assistant, Malmaze Laboratuari, Teknik Universite, Istanbul, Turkey. [J]
YUEN, TANK KWOK, Manager, Honor Trading Co., 19 Sai Yuen Lane, Box 1030, Hong Kong, China.

* [J] denotes Junior Member.

NECROLOGY...

The death of the following members has been reported

JOSEPH R. BARR, President, Barr & Barr, Inc., New York, N. Y. (May 6, 1950). Member since 1923.

OLIVER C. CROMWELL, former Assistant to Chief of Motive Power and Equipment (Retired), Baltimore & Ohio Railroad Co., Baltimore, Md. (March 30, 1950, at the age of 89 years). Long affiliated with the B&O, and one of the oldest members of A.S.T.M., his membership dating from 1906, Mr. Cromwell was very active, particularly in the early years of the Society. He served on numerous committees including A-1 on Steel, and was particularly alive to the needs and problems of the railroad industry in which he was a leader. In his death the Society loses a member who labored long in many capacities to advance its work in standards and research.

E. M. EDGERTON, Pacific Mills, New York, N. Y. (March 26, 1950). Representative of his company since 1942 on Committee D-13 on Textile Materials, also representative of the National Association of Finishers of Textile Fabrics, and of the Textile Fabrics Association on A.S.A. Sectional Committee on Textile Test Methods during the same period.

PAUL B. GUYER, Chief Metallurgist, Cia Siderurgica Nacional, Volta Redonda, Brazil (March 22, 1950). Member since 1949.

FRED HEATH, Secretary and Executive Director, Mason Material Dealers Assn., Memphis, Tenn. (May 4, 1950). Mr. Heath joined A.S.T.M. in 1936 while serving as Secretary-Engineer, The Brick Manufacturers Assn. of New England. He was later associated with Colonial Clays, Inc., Worcester, Mass., and Owens-Corning Fiberglas Corp., Toledo, Ohio. He served for some time on former A.S.T.M. Committees on Brick and Hollow Masonry Building Units, and from 1936 to 1946 was very active in various subgroups of Committee C-15 on Manufactured Masonry Units, representing The American Ceramic Society on C-15 for several years. More recently he has held membership on this committee as an officer of the Mason Materials Dealers Assn.

ADDISON F. HOLMES, Professor Emeritus of Applied Mechanics, Massachusetts Institute of Technology, Cambridge, Mass. (November 5, 1949). Member since 1906.

G. E. F. LUNDELL, former Chief, Chemistry Division, National Bureau of Standards, Washington, D. C.; residence, 402 Cummings Lane, Chevy Chase, Md. (June 8, 1950). Member since 1918. (See article on page 54.)

JOHN B. MACDONALD, Owner and Manager, Macdonald & Macdonald, Vancouver, Canada (May 6, 1950). Member since 1924.

ARTHUR G. SMITH, President, Pacific Testing Laboratories, Seattle, Wash. Member since 1940.

G. E. F. LUNDELL
1881-1950

IN THE death of Dr. Lundell, for many years Chief, Chemistry Division, National Bureau of Standards, and a Past-President of A.S.T.M., the Society and the whole field of analytical chemistry loses one who contributed greatly to many phases of this work.

A graduate of Cornell University, where his Ph.D. degree was earned in 1909, he subsequently taught at Northwestern University, and was for many years Assistant Professor at Cornell. In 1917 he joined the staff of the National Bureau of Standards as Chemist, and was Chief Chemist from 1937 until his retirement

about two years ago. Dr. Lundell was particularly concerned with the analysis of ores, metallurgical materials, and directed the Bureau's preparation of standard samples, which work expanded greatly under his direction.

He was active in the work of many A.S.T.M. committees, particularly those in the metals field, and headed several of these groups' subcommittees on chemical analysis until Committee E-3 took over full responsibility in this field. He was Chairman of Committee E-3 on Chemical Analysis of Metals from its organization in 1935 until 1948. In many ways his work in this committee might be considered his most notable contribution to the Society and to industry.

Dr. Lundell was a member of the A.S.T.M. Board of Directors (1937-1939), later Vice-President, and was President (1941-1942).

He was very active in the work of the American Chemical Society and other technical groups. He wrote widely and was co-author of three leading texts covering chemical analysis.

Dr. Lundell labored long and intensively for A.S.T.M. He had a keen appreciation of the important work which the Society could do, and he did his full share to advance those phases in which he was an authority.

The Society extends its sympathy to Mrs. Lundell and members of his family.

LABORATORY SUPPLIES . . .

Catalogs and Literature and Notes on New or Improved Apparatus

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses.

Catalogs and Literature

Arthur H. Thomas Co., West Washington Square, Philadelphia 5, Pa. The issuance of a completely revised and expanded Thomas catalog entitled "Laboratory Apparatus and Reagents" is an event in the laboratory apparatus field. The former editions of this catalog have established it as one of the outstanding books in the field and the current edition, the first new one after many years, will not detract from the reputation of the earlier books or of the company. How to present an adequate description of the 1470-page book is a complicated task, but one could say that the catalog seems to cover almost everything in the apparatus and reagent field from the A.A.C.C. Moisture Flask to Zoological Blow Pipes.

Many of the instruments and equipment necessary for A.S.T.M. tests are described, with detailed listings in the 61-page index. The reagent section printed on colored stock covers 124 pages divided into twelve sections, among other items covering microanalytical reagents and Feigl spot-testing reagents. Among features which make this catalog outstanding are the detailed and carefully prepared descriptions of the equipment, with in many instances extensive bibliographical references; and secondly, the clarity of the illustrations which is in part due to the use of wood cuts. The apparatus and laboratory supply section of the catalog comprises some 1272 pages. The items are described under logical alphabetical classifications which with the extensive index makes for quick reference to a designated subject.

New 1000-lb. Combination Shipping Package Testing Machine—L. A. B. Corporation, Summit, N. J. With this machine a package may be both vibration tested and impact tested without removing the package from the testing table. The impact forces and the vibration motions and magnitudes are the same as those ex-

perienced by a package in a railway car or a truck. Impacts are made by raising the table which carries the test package with its nose protruding, to any predetermined height up to 20 in. and letting it drop. The table is hung on four arms which form a pantograph pendulum arrangement.

Nickerson-Hunter Cotton Colorimeter—Henry A. Gardner Laboratory, Inc., 4723 Elm St., Bethesda 14, Md. The instrument was designed to show graphically on a two-dimensional scale simultaneous values for reflectance and yellowness. It is self-contained in a movable cabinet about table height, with a minimum of exposed parts. The exposure of samples and reading of results are done in the horizontal plane of the table. Electrical measurements of photocell currents are converted to color as in the Color-Difference Meter, except that Brown Electronic amplifiers replace the galvanometer, and reversible motors, responding to the signals from these amplifiers, replace the human operator, both in standardizing the instrument and in turning dials to obtain color settings. While this particular instrument is limited to the range of cotton colors, the principles upon which it is designed are adaptable to other limited ranges of color, in either two or three dimensions.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. For the convenience of research people interested in polarographic analysis, a new bibliography of scientific papers on this subject has been prepared; 2208 references are listed in chronological order, covering a wide variety of applications for this versatile analytical method. Articles listed cover the period from the earliest preliminary investigations in 1903 up to the middle of 1949, and include all available foreign and domestic sources. Titles originally in

other languages have been translated into English, and the language of original writing is indicated at the end of the reference. Papers are cross-indexed alphabetically by author and by subject matter; 1310 authors and 903 main subject classifications are included. Single copies (only) may be obtained without charge.

The Emil Greiner Co., 20-26 N. Moore St., New York 13, N. Y. General Laboratory Equipment and Apparatus Catalog—Eleventh Edition. In the 736 pages of this new catalog are described thousands of regular and special instruments and equipment used for testing and research in a great diversity of fields. The catalog is made very useful by brief descriptions of the operations and objectives of the apparatus. While the Petroleum Section in which Greiner has done a particularly widespread business is extensive covering just over 100 pages, there are other catalog sections of considerable extent.

The illustrations are clear, and the general arrangement and format of the pages including the selection of type makes for ease of reading. The alphabetical index, which lists every item in the catalog and is a most important part of any instrument catalog, comprises 37 pages. The numerous references to A.S.T.M. are given under subject as well as serial designation listings. These numerous A.S.T.M. listings indicate to some extent the significance of A.S.T.M. standards in the apparatus field.

"Dust-Free" Tester—Henry Zuhr, Inc., 187 Lafayette St., New York 13, N. Y. The need for a simple, practical method of determining drying time of paint and varnish film accurately resulted in the designing and building of the "Dust-Free" Tester, using "Multiflex," a white dust, as medium. A buzzer-button causes dust to fall through a mesh wire screen, depositing a thin, uniform layer in a well-defined pattern strip. Dust deposits are made at regular intervals over a new part of the film being tested, starting at the top and working downward. Then a light stream of air is blown over the film, followed by gentle rubbing with a soft cloth. The drying time is established when the dust no longer adheres to the film. This "dust-free" point is unmistakable on any material, even on white coatings. The tester can be used on film as narrow as 1½ in. to as wide as 3¾ in.

Annual Address by the President

James G. Morrow,¹ June 27, 1950

AN UNWRITTEN rule prevails in the A.S.T.M. that the Presiding Officer at each Annual Meeting shall deliver an address. What is said by me today is in compliance with that custom and will be pretty much in the form of an informal talk.

Last year President Templin ably forecast our work for the near future, and in the two preceding years Presidents Boyd and Carpenter, from somewhat different approaches, touched upon the progress in the first 50 years of the Society's history. It remains for me, therefore, only to comment to you on current activities in general.

Our Society was planned and founded by men of vision, rugged honesty, great ability, and fairmindedness. Their experience was broad and their judgment sound. The A.S.T.M. has faithfully maintained the ideals of its founders throughout the years, and today is outstanding and unique in its field.

In forming our committees, great care is exercised in the selection of members so that all interests will be represented in the personnel composing the committee. Long experience has demonstrated that it is impossible for a standard to win general recognition when its committee is not wholly representative of the industries involved.

In A.S.T.M. committees, the freest possible expression of the views of all members—each of whom has an equal voice in the work brought formally to the Society for group consideration and adoption—is the practice. This method of conducting our business gives each consumer, producer, or independent engineer a fair chance to speak and be heard and to present to the respective committees all angles and phases of the problems under consideration.

Much thought is given by each committee in the preparation of its standards. This provides full assurance to the public that the materials purchased and inspected in accordance with the recommendations of this Society will result in furnishing the best that can be produced at the lowest possible cost, and at the same time afford all safety necessary to the public welfare.

Revisions in our many specifications are made from time to time as increased scientific knowledge and experience

dictates. Our Society is furnishing much assistance to, and is in close relationship with, various interests using and producing materials in accordance with our specifications. From a meager beginning of \$54 in 1902, our sale of publications has risen to an estimated \$300,000 in 1950. This indicates the steady growth in the demand for and the usefulness of our standards. The sum mentioned represents slightly more than one half of our total income.

The soundness and competence of our Society's specifications have created an international as well as a national reputation. No engineering society stands higher, and none commands greater respect. The influence of its work is far reaching because its activities are closely attuned to the needs of those whom it serves—whether they be in engineering, in industry, or in government.

The great diversity of the Society's work—cutting across every major materials field—makes it almost impractical to even briefly cover it. Only the highlights of major A.S.T.M. accomplishments will be referred to, and we shall not attempt to forecast particular trends except to mention, in passing, the vast field which will be ours as science unfolds the applications and uses of isotopes, and on which committee work is now being undertaken. It might be well to mention also the closer relationship and cooperation that now exists with the Armed Services at Washington.

Many of the Society's technical committees have made major strides in various phases of their work. The organization of new technical committees has continued. More consideration, time, and effort than is generally realized is devoted to the formation of new technical groups. In organizing these new groups it must first be established that both producer and consumer will give good support to the project, if A.S.T.M. undertakes it. Then the logical technical division into which the product falls for development must be decided. These unpublished problems require fairminded judgment and consideration.

Our technical groups in their general order are Ferrous Metals; Non-Ferrous Metals; Cement, Ceramic and Related Materials; Miscellaneous Materials, including Paints, Textiles, Petroleum, Gaseous Fuels, Electrical Insulation, Rubber Products, etc.; and also the group dealing with general methods of testing.

These committees and their subcommittees are composed of many of the country's leading technical men who have cooperated, inspired, worked and produced outstanding documents which will benefit industry and governments, particularly on this North American Continent. Many worth-while contributions have been made by our committees to our knowledge of the properties and the tests of materials and also in standardizing specifications.

A great amount of work is carried on by these committees. To bring this clearly before you, at the last meeting of Committee A-1 on Steel, it took 2½ hours for subcommittee chairmen to briefly abstract their reports so that Committee A-1 might be able to present a summary of its 1950 work at this Annual Meeting for your approval. Committee A-1 has developed specifications of wide moment and application. They are the so-called Master Specifications for Structural Steels with their allied products. The influence of these specifications will be far-reaching and is indicative of the enormous amount of work and unselfish splendid effort of the members of this and other committees involved in the development of our specifications and research programs.

I have referred to our Steel Committee particularly, but the same applies to all our committees. Without exception each committee, whether it be on paint, rubber, petroleum, plastics, timber, electrical insulation, or the newer committees on such subjects as non-destructive testing, quality control of materials, or asbestos-cement products, has been doing a tremendous amount of work and has accomplished much.

Our working committees who are responsible for all specifications and development and research work, have a membership, eliminating duplication, of more than 2600. This is over one third of our total membership and demonstrates clearly that A.S.T.M. is an organization of workers from whom much has come and from whom much can be expected.

Those who have been in touch with the international setup realize how difficult is the task of international standardization because of different conditions prevailing in different countries and on several continents, and the lack of a common language. The apparent feeling in some countries is that international specifications would

¹ Metallurgical Engineer, The Steel Company of Canada, Ltd., Hamilton, Ontario, Canada.

militate against their export trade. The situation, however, offers some promise, and in view of our already successful efforts along certain lines, I feel that we should continue with this important work.

In October of last year, our Society held its first meeting on the West Coast. It was the opinion of those who attended this first Pacific Area National Meeting in San Francisco that it had much the character of an Annual Meeting. There were close to 1000 in attendance along with 110 ladies. The Technical Sessions (15 in all) were well attended and the papers were excellent. The traditions of the West were maintained with splendid committees, excellent leaders,

and lots of enthusiasm. They planned well and worked hard in providing a strong technical program as well as a fine entertainment program. Western Meetings are a "must" for the future.

The work of our Board of Directors and of the Administrative Committees is set out in detail in the Report of the Board of Directors. This is our "Book of Words" for the year. It has been a tremendously productive year. Our technical activities, publications, and meetings are dealt with in their entirety for your information. Your officers and committees have labored faithfully on all fronts. This Board report indicates that their efforts have not been unsuccessful and splendid cooperation has been shown.

In closing, I should like to express my deep appreciation for the splendid help that has been accorded me on every side during my tenure as President. I particularly want to express appreciation to Mr. Warwick and the Headquarters' Staff who have been most considerate, and who are doing such an excellent job. I wish to reiterate that great honor has come to Canada and to me in making me your President and permitting me to serve this great and influential organization. The strong ties already existing between our countries have been fortified by your generous gesture. My thanks to all of you for your exceeding great kindness.

Stress Cracking of Polyethylene*

By R. H. Carey¹

SYNOPSIS

The effects of some environments upon the tensile properties of polyethylene are reported. It is found that tension specimens containing a small hole break at stresses and elongations less than those normally reported. This change in mechanical properties is greatly accentuated by fluids such as alcohols and toluene. This phenomenon is compared to "stress corrosion cracking" as observed in metals where cracking occurs in mildly corrosive environments.

Data are reported for a wide range of molecular weight polyethylene resins, and the effects of environment are found to decrease with increasing molecular weight of the resin. The data permit quantitative comparison of the cracking resistance of different resins.

The properties of polyethylene are compared with older more common materials. It is shown that polyethylene is not a "rubber-like" or "elastomeric" material but more nearly resembles some non-ferrous metals. This comparison is inferred from its crystalline structure, stress-strain diagram, and "stress corrosion cracking" phenomenon.

THE expanding and varied industrial use of polyethylene requires an understanding of the measurement and interpretation of its mechanical properties. Since polyethylene is a relatively new thermoplastic, its suitability for different applications has not been well established. A new material is often judged from past experiences on older materials, and it is of interest to compare this thermoplastic with others that are already established and which have well-known characteristics. Such comparisons are of a general nature, however, and should be treated only as a rough guide for those who are unacquainted with polyethylene.

In many ways, polyethylene resembles a soft non-ferrous metal having a non-

linear stress-strain curve and great "ductility" (1).² The analogy may be carried even farther since polyethylene has some degree of crystallinity (2, 3, 4) and, in common with metals, it is also susceptible to the phenomenon of "stress-cracking" or "stress-corrosion" (5). This characteristic results in fracture at elongations less than those ordinarily observed in a tension test. The extreme "ductility" and low modulus of elasticity of polyethylene have frequently resulted in its classification erroneously, as a "rubber-like" material. The "ductility," as shown by extremely great elongations, is achieved, however, only under ideal conditions in uniaxial stressing. Under certain environments and conditions of stressing, polyethylene suffers a reduction in elongation which is particularly disturbing if judged from the "rubber-like" viewpoint. The "metallurgical" or "metallic" viewpoint, on the other hand, predicts such "embrittlement."

The properties of compression-molded polyethylene are usually represented by stress-strain curve as shown in Fig. 1.

These curves may be roughly divided into three regions.

1. From zero to 50 per cent strain, a "pseudo-elastic" behavior is observed. A rapid increase in load with comparatively little strain is followed by a general yielding producing a sharp "knee" similar to that observed in many metals.

2. From 50 to 350 per cent strain, the material flows and deforms "plastically." The initial yield point is often followed by a drop in load and a lower yield point. Reductions in area become apparent and "necking" occurs.

3. From 350 per cent to failure, increasing loads are observed. This region of the curve is greatly affected by the geometry of the specimen and techniques of testing. At these extreme elongations, stress-strain curves of polyethylene, or of any yielding materials, are of questionable validity since localizations of strain (necking) render strain measured between gage marks meaningless.

Although curves such as Fig. 1 are very useful, the region between zero and 20 per cent strain, the "elastic" region, of prime importance in practical applications, is so condensed that no accurate information concerning this region can be obtained. By using higher strain magnification and slower testing speeds, stress-strain curves of the type shown in Fig. 2 have been obtained for injection molded polyethylene (6). From such stress-strain curves, the properties of polyethylene have been studied over a temperature range from -60 C. to +25 C. and over a molecular weight range from 16,000 to 38,000 (Williams Plasticity D-30 to D-200) (7). Such high-strain magnification curves have

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* Presented at the Fifty-Third Annual Meeting of the Society, June 26-30, 1950.

¹ Bakelite Div., Union Carbide and Carbon Corp., Bound Brook, N. J.

² The boldface numbers in parentheses refer to the list of references appended to this paper.

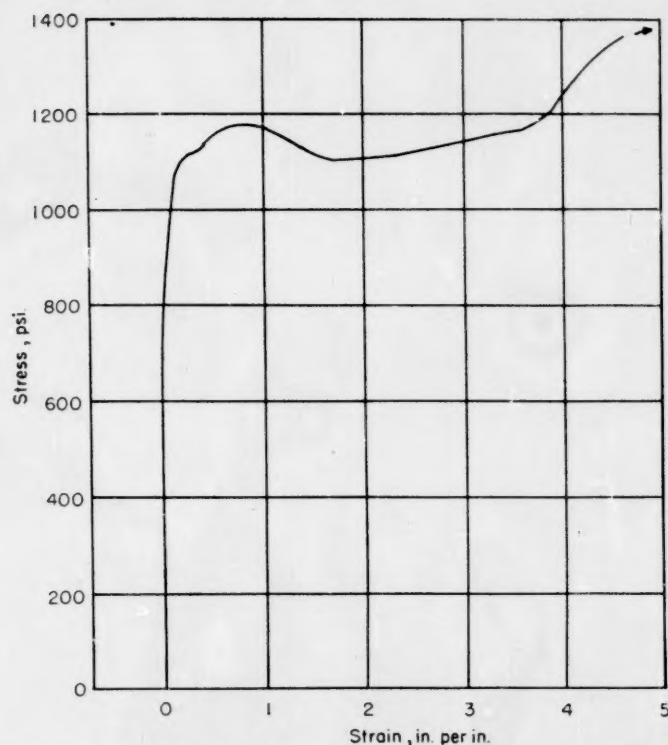


Fig. 1.—Stress-Strain Curve of Compression Molded Polyethylene, Extending to 500 per cent Strain.

also been useful for studying filled polyethylene (8). Near room temperature, this curve is exponential and shows no well-defined yield point. This again is analogous to many non-ferrous metals.

As a convenience in interpreting the stress-strain curve, an arbitrary "elastic" limit has been defined as the point on the curve at which the slope is 50 per cent of the slope at the origin. For all molecular weight polyethylene resins, this point has been found to be at about 4 per cent strain (6). At 7 to 10 per cent strain, yielding is quite pronounced and the modulus has fallen to about 25 per cent of the initial value. Apparent modulus of elasticity and stress at the "elastic" limit were found to increase (near room temperature) with increasing molecular weight. This arbitrary selection of "elastic" limit agrees favorably with long-time creep tests reported by Gohn, Cummings, and Ellis (9).

The "stress-cracking" phenomena were first observed in "semi-quantitative" tests where thin strips of the sample were bent through 180 deg., scored with a razor, and immersed in active chemical agents. After a period of time, depending upon the resin, the temperature, and the chemical agent, fracture occurs (of a brittle nature) on the scored side which is held under a tensile stress. From this exploratory testing and other data (10) it was apparent that the principal factors affecting this cracking were tensile stress, corrosive agent, temperature, and time. It is the purpose of this paper to show the relative importance of some of these factors.

immersed in the liquid. The specimen was then immersed in the fluid and held at the top by another grip which was partially immersed in the fluid. As the specimen elongates, extension rods drive an extensometer. Load-elongation curves were then autographically plotted (for a 2-in. gage length) as the specimen was tested.

PROCEDURE

Exploratory tests with tension specimens die cut from extruded stock showed a much lower breaking strain when tested in ethyl alcohol than when tested in air. Qualitatively, it appeared that the higher molecular weight resins were more resistant to the action of the alcohol. The die-cut specimens, however, possessed many surface irregularities because of the cutting action of the die. Injection-molded tension specimens were then made, and it was found that with no surface imperfections, "brittleness" was not apparent even in the lower molecular weight resins. If the edge of the specimen were nicked or scored, however, fracture occurred in a brittle manner.

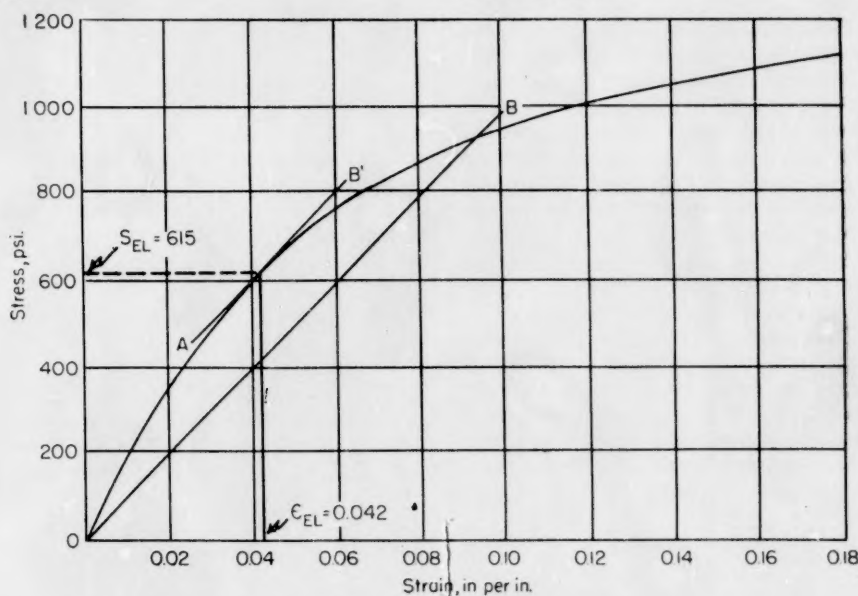


Fig. 2.—Stress-Strain Curve of Injection Molded Polyethylene, Strain Axis Magnified and Extending to 18 per cent Strain.

APPARATUS

It was believed that the phenomenon of cracking might be better understood if the effects of creep and relaxation were minimized. Consequently, a device was built, schematically shown in Fig. 3, which made it possible to obtain stress-strain curves of the material while immersed in fluids. The fluid under test was contained in an up-ended 2-gal. bottle from which the bottom had been removed. This bottle was rigidly attached to the lower crosshead of a hydraulic testing machine. The lower grip was mounted inside the bottle and

Several tests with the nicking technique, although qualitatively indicating "brittleness," did not show sufficient reproducibility to distinguish between resins. Since this nicking technique is difficult to control, it was abandoned and the "stress-raiser" was produced by drilling a $\frac{1}{16}$ -in. diameter hole through the center of the specimen. With a specimen $\frac{1}{2}$ in. wide ($\frac{1}{8}$ in. thick), the hole diameter-specimen width ratio is then 0.125. This provides an arbitrary geometrical condition which serves to distinguish between materials and is the same order of magnitude as that used in

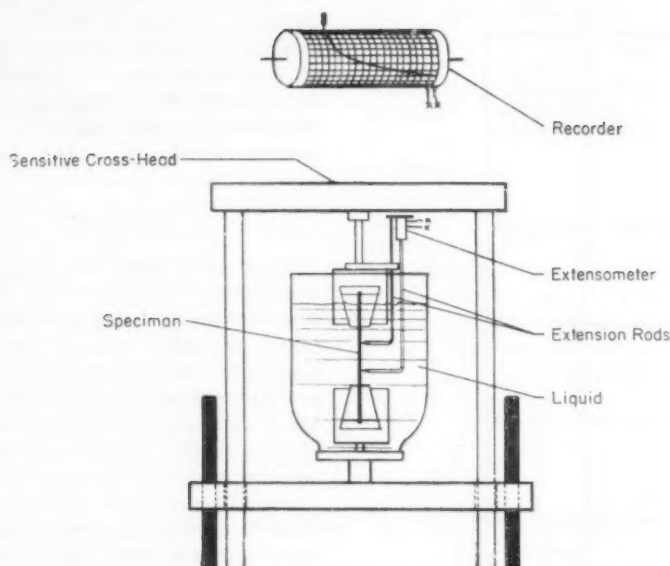


Fig. 3.—Schematic Drawing of Immersion Testing Apparatus.

tests of aluminum (11). The test value should not be applied, however, to other geometrical configurations.

The complete stress-strain curves indicated that the presence of a hole and a chemical agent resulted primarily in a shortening of the curve. The shape of the initial portion was not appreciably altered. Consequently, resins and fluids are quantitatively compared by the stress and strain at fracture. Stresses are nominal values based on the net cross-sectional area and strains are the gross values obtained over a 2-in. gage length. The local strains and stresses are undoubtedly higher over short gage lengths in the vicinity of the hole.

One specimen of each resin, without a hole, was tested in each fluid. Duplicate specimens, containing holes, were tested in all fluids except ethyl and *n*-amyl alcohol where four and five specimens were used. The results given are the average of these tests.

MATERIALS

The tension specimens (A.S.T.M. D 638-46 T,³ Specimen Type I, $\frac{1}{8}$ in. thick) used in these tests were injection molded from six resins ranging in molecular weight from 18,500 to 29,000. The molecular weights were determined by a solution viscosity method as described by Kemp and Peters (12). The resins are identified and described in Table I where they are arranged in order of increasing molecular weight. Five of the resins were molded at 450 F. and one at 400 F. in a relatively cold mold. All specimens were formed in a 3-oz. Watson-Stillman injection molding ma-

³ Tentative Method of Test for Tensile Properties of Plastics, 1949 Book of A.S.T.M. Standards, Part 6, p. 585.

chine. These conditions are representative of normal production procedures.

Tension specimens, with and without the $\frac{1}{16}$ -in. diameter hole, were made from each resin and tested in the following fluids:

1. Air
2. Distilled water
3. Soapy water (0.5 per cent potassium stearate)
4. Ethyl alcohol (denatured 9 per cent methanol)

TABLE II.—TENSILE BREAKING STRAIN OF INJECTION MOLDED POLYETHYLENE NOMINAL VALUES OVER A 2-IN. GAGE LENGTH— $\frac{1}{16}$ -IN. HOLE.

Sample	Environment						
	Air	Distilled Water	Soapy Water	Ethyl Alcohol	<i>n</i> -Amyl Alcohol	<i>t</i> -Amyl Alcohol	Toluene
No. 1.....	51	60	51	18	7	7	14
No. 2.....	62	54	41	38	15	13	18
No. 3.....	39	42	46	36	20	20	14
No. 4.....	45	45	51	44	25	20	21
No. 5.....	42	44	44	40	29	26	20
No. 6.....	48	47	47	44	36	38	38

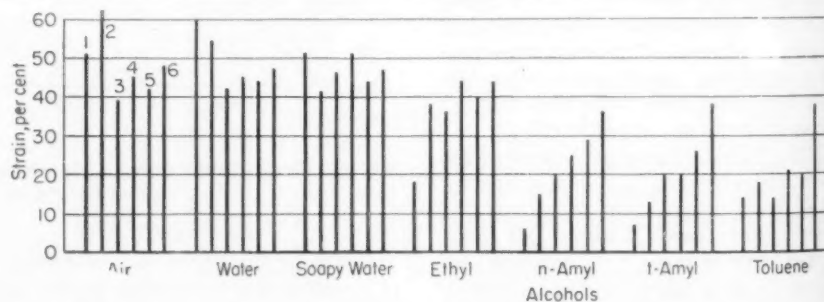


Fig. 4.—Breaking Strain of Specimens Containing a $\frac{1}{16}$ -in. Diameter Hole.

5. *n*-Amyl alcohol
6. *t*-Amyl alcohol
7. Toluene

These fluids were obtained commercially from several sources, and are believed to be representative of commercial standards for such materials.

TEST RESULTS

One specimen of each resin, without a

TABLE I.—MATERIAL IDENTIFICATION

Sample	Solution Viscosity, Average Molecular Weight	Molding Temperature, deg. Fahr.
No. 1.....	18 500	450
No. 2.....	21 900	450
No. 3.....	22 000	400
No. 4.....	24 700	450
No. 5.....	27 000	450
No. 6.....	29 000	450

* Different lots of same resin.

hole, was tested in each fluid. Of these 42 specimens, all but six broke at the normally expected elongation of from 70 to 140 per cent. Since this is out of the range of the extensometer, the elongations were measured approximately with a scale and are reported simply as being over 70 per cent. Such elongations, although quite large, are considerably under the 400 to 600 per cent value commonly reported for extruded or compression molded samples of equivalent molecular weight where the "necking" and "drawing" phenomenon is usually more pronounced. In all cases (except one) the specimens without holes were strained to greater elongations than those with a hole. The difference between plain specimens and those with a hole is accentuated by the surrounding environment, although there are a few indications that the alcohols and toluene tend to "embrittle" polyethylene even when no "stress-raisers" are present.

The effect of environment is most pronounced upon the specimens containing a hole. Table II and Fig. 4 compare the breaking strain (2-in. gage length) of the several resins when tested in the various fluids. All of the resins, regardless of molecular weight, break at about 40 to 50 per cent strain when tested in air and in distilled or soapy water. In the alcohols and toluene,

TABLE III.—TENSILE BREAKING STRESS (IN PSI) OF INJECTION MOLDED POLY-ETHYLENE NOMINAL VALUES FROM NET CROSS-SECTIONAL AREA AT HOLE.
2-in. Gage Length— $\frac{1}{16}$ -in. Hole

Sample	Air	Distilled Water	Soapy Water	Ethyl Alcohol	n-Amyl Alcohol	t-Amyl Alcohol	Toluene
No. 1.....	1220	1360	1260	1010	790	810	970
No. 2.....	1620	1680	1660	1560	1240	1250	1310
No. 3.....	1780	1830	1740	1660	1420	1400	1330
No. 4.....	1750	1890	1900	1810	1550	1520	1460
No. 5.....	1930	2120	2080	2020	1900	1860	1670
No. 6.....	2160	2250	2240	2210	2080	2100	1900

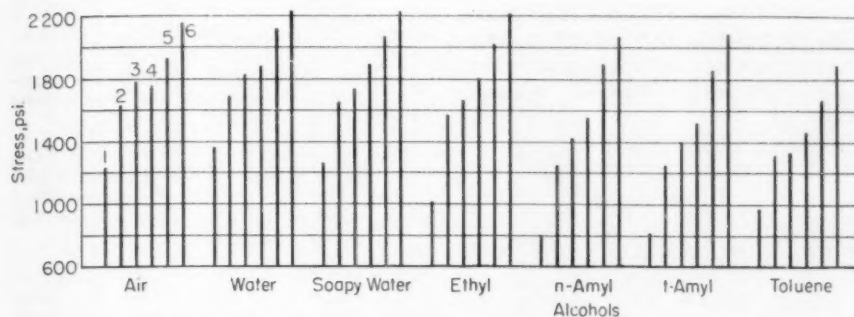


Fig. 5.—Breaking Stress of Specimens Containing a $\frac{1}{16}$ -in. Diameter Hole.

NOTE.—Numbers on bar diagram refer to different molecular weight resins, arranged in order of increasing molecular weight.

however, the elongations, although less than in air, are dependent upon molecular weight. This is particularly true in *n*-amyl and *t*-amyl alcohol where regularly increasing elongation occurs with increasing molecular weight. The absolute value of the elongation is in all probability affected by the type of geometrical discontinuity; consequently, the values given will apply only to this special case.

Table III and Fig. 5 compare the specimens (with a hole) on the basis of stress. The breaking stress is dependent upon the molecular weight whether tested in air or alcohol. This is consistent with previous work (6) where stress at the "elastic" limit was found to be dependent upon molecular weight and strain at the "elastic limit" was independent of molecular weight. The lowest molecular weight resins are more greatly "embrittled" by alcohol and toluene than the highest molecular weight resins. Stress at fracture follows a more regular pattern with molecular weight than strain at fracture.

The significance of the breaking stress and strain may be judged from Table IV, where the individual results for three resins tested in ethyl alcohol are given. Between 18,500 and 21,900 molecular weight there appears to be a decided improvement in crack resistance. Between 21,900 and 24,700 molecular weight there is some improvement but it is not large and may be influenced by molding conditions. Since these data apply to only one fluid of an infinite number possible, the data must not be overgeneralized. The breaking stress and strain in a practical application will also be a function of the geometry of the part.

DISCUSSION

Polyethylene has been reported to have an elongation as high as 400 to 600 per cent. It is doubtful, however, if such an elongation can be reached in practice where bi-axial stresses or stress concentrations prevent the realization of a full draw. Consequently, this high strain figure is of little significance. Any discontinuity, such as a hole, will produce concentrations of stress and strain which are functions of geometry and not related to the material tested. These concentrations may be minimized, however, by the ductility of the material.

It was reported previously (5) that an "apparent elastic limit" of polyethylene can be established on the stress-strain curve at the point where the slope is 50 per cent of the slope at the origin. The strain at this point is found to be about 4 per cent for all molecular weight resins. At 7 to 10 per cent strain, yielding is quite pronounced and the modulus has fallen to about 25 per cent of the initial value. Because of strain concentrations in a specimen containing a hole, the over-all elongation at failure is considerably reduced by geometrical factors. For the several polyethylene resins tested, it was thus found that the elongation at failure ranged from a minimum of 39 per cent to a maximum of 72 per cent when tested with a hole and in air.

Although a hole reduces the over-all elongation of a specimen, the combination of a hole and certain fluids will produce an even greater reduction. Air, distilled water, and soapy water produce about the same breaking elongation in all molecular weight resins. The alcohols and toluene, however, tend

to reduce the breaking strength and elongation of all molecular weight resins. Low molecular weight resins are more greatly "embrittled" than the high molecular weight samples. Normal and tertiary amyl alcohol are particularly selective with respect to molecular weight, while the "embrittlement" in ethyl alcohol and toluene is relatively independent of molecular weight. Over this wide range of weights, it may be said that increasing the molecular weight produces an increased resistance to cracking. It would be erroneous to conclude, however, that the test is sufficiently precise to be able to distinguish between any two adjacent resins since molding conditions are also of primary importance.

"Plastic" deformation in crystals is usually accompanied by sliding along certain crystallographic planes. Sliding or "yielding" begins when the magnitude of the shearing stress reaches a limiting value. In so-called "brittle" materials, stretching due to sliding is small, and fracture occurs by overcoming cohesion and the material has a brittle fracture. The type of fracture occurring is very dependent upon the method of testing. A "ductile" material may have a brittle type of fracture if the form of test specimen or type of stress distribution is such that deformations due to sliding are prevented.

TABLE IV.—TENSION TESTS OF INJECTION MOLDED POLYETHYLENE DRILLED $\frac{1}{16}$ -IN. HOLE.

Tested in Ethyl Alcohol (denatured).

Sample	Stress and Strain at Fracture		Molecular Weight
	Stress, psi.	Strain, per cent	
No. 1....	860	9	18 500
	1020	16	
	1200	43	
	860	7	
Avg.....	1090	14	21 900
	1010	18	
	1520	20	
	1540	46	
No. 2....	1560	46	24 700
	1620	39	
	1540	39	
	1560	38	
Avg.....	1820	48	24 700
	1790	45	
	1790	42	
	1820	43	
Avg.....	1800	44	

The maximum shearing stress is equal to $(S_x - S_y)/2$ where S_x and S_y are the maximum and minimum principal stresses (13). In a simple tension test, the shear stress is one half of the tensile stress because the other principal stresses, S_y and S_z , are zero. In such cases sliding occurs and a shear or "ductile" type failure results. If the principal stresses are nearly equal, however, the shear stress is near zero and fracture occurs on the plane of maximum tensile stress before sliding can occur and the fracture is termed "brittle." Because of necking, nicking, or other geometrical factors producing an irregularity in

shape, some specimens apparently subject to uniaxial tension are acutally subject to bi- or tri-axial stressing (14). Under such conditions the shear stresses are near zero and the material cracks or exhibits a "brittle" fracture.

For these reasons, it is necessary that the complete stress-strain curve of polyethylene should be well understood. The alcohols and solvents used in these tests show their effect principally in a shortening of the stress-strain curve. That is, whether tested in alcohol or air, the initial part of the curve is very similar. Yielding or sliding is somehow prevented by the "solvents" and the material fractures in a brittle manner.

Undoubtedly, time is an important factor in "embrittlement." No attempt has been made in these experiments to control this factor other than to make all tests at the same rate of straining (0.1 in. per min.), and to avoid unduly long immersions. The actual immersion time is about 2 to 10 min. Several literature references (10) show that glass in air, brass in ammonia, and methyl methacrylate in carbon tetrachloride will fracture at widely different times under different dead weight stresses. Log time to fracture is approximately linear with stress. Methyl methacrylate in carbon tetra-chloride at 4000 psi. fractures in about 800 sec. and at 1500 psi., in about 200,000 sec. It is the author's opinion that the time element, since it is logarithmic, is of less importance than

nonuniform or poorly controlled stress distribution such as in a severe bending test

Acknowledgments:

Thanks are due G. G. Himmler and R. Bostwick for preparation of the injection molded specimens and W. F. Hemperly, W. A. Haine, and N. R. Smith for the extruded specimens. The assistance of L. M. Baxt in determining the molecular weight and selecting the test fluids is gratefully acknowledged.

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Resistance of Representative Plastic Materials to Hydrofluoric Acid

By Frank W. Reinhart¹ and Harry C. Williams, Jr.¹

SINCE INQUIRIES are frequently received particularly from workers designing and building laboratory equipment, about the resistance of plastic materials to hydrofluoric acid, tests were made to obtain some data which might be of assistance in answering such inquiries.

The general procedure used is similar to that described in the A.S.T.M. Method of Test for Resistance of Plastics to Chemical Reagents (D 543 - 43)² (Method No. 7011 of Federal Specification L - P - 406a). The limitations of

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¹ Organic Plastics Section, National Bureau of Standards, Washington, D. C.
² 1949 Book of A.S.T.M. Standards, Part 6, p. 692.

this method should be recognized in applying the data presented. A limiting factor in the practical value of the results obtained in this test is the relatively short time of immersion, namely, a maximum of 28 days. Another limiting factor is that the criteria of changes in weight, dimensions, and appearance are

often insufficient to reveal adverse effects of the chemical on the strength and electrical properties. Also, the surface appearance may be marred but the serviceability may be unaffected. When the results are interpreted in accordance with these limitations inherent in the test procedure, the comparison of

TABLE I.—IDENTIFICATION OF PLASTIC MATERIALS.

Sample Designation	Type of Plastic	Thickness, Average in.	Density, g. per cu. cm.
1.....	Phenolic paper laminate, grade X	0.121	1.41
2.....	Phenolic fabric laminate, grade C	0.124	1.36
3.....	Phenolic fabric laminate, grade C	0.138	1.37
4.....	Phenolic fabric laminate, post-forming	0.063	1.38
5.....	Phenolic asbestos laminate, grade AA	0.150	1.51
6.....	Urea-formaldehyde molded, cellulose filler	0.150	1.50
7.....	Melamine-formaldehyde molded, cellulose filler	0.135	1.43
8.....	Melamine-formaldehyde molded, asbestos filler	0.141	1.41
9.....	Polyvinyl chloride-acetate, white opaque sheet	0.136	1.41
10.....	Unsaturated-polyester glass-fabric laminate	0.127	1.88
11.....	Polymethyl methacrylate, cast	0.226	1.21
12.....	Polystyrene, molded	0.125	1.06
13.....	Polyethylene, molded	0.134	0.83
14.....	Cellulose acetate, molded	0.267	1.30

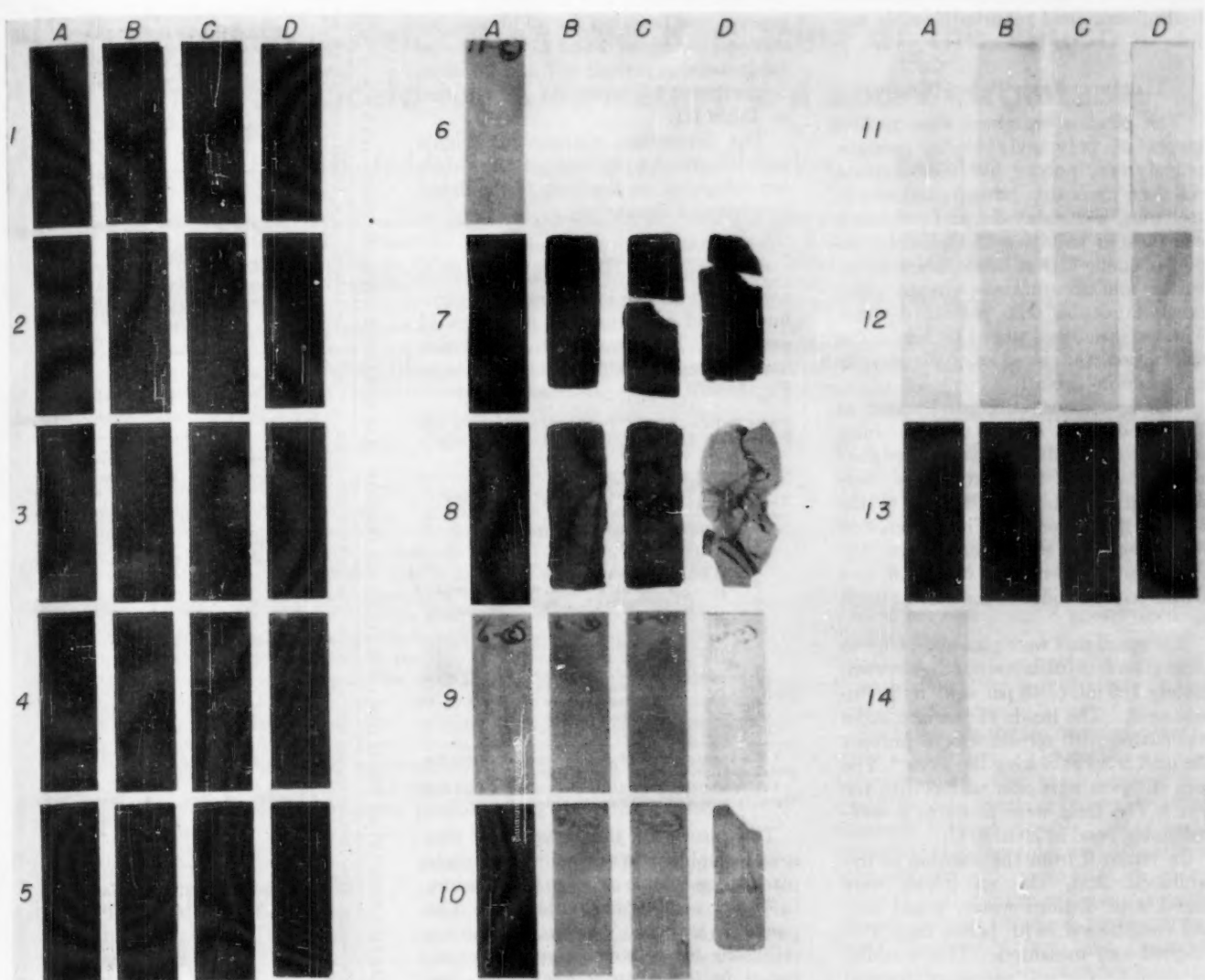


Fig. 1—Appearance of Various Plastics After Immersion in 48 per cent Hydrofluoric Acid at 20 to 30 C.

A—Original specimens.
B and C—Specimens after 7 days' immersion.
D—Specimens after 28 days' immersion.

TABLE II.— CHANGE IN WEIGHT AND DIMENSIONS OF PLASTICS RESULTING FROM CONTINUOUS IMMERSION FOR 7 DAYS IN HYDROFLUORIC ACID.^a

Sample Designation	Weight Change, per cent			Length Change, per cent			Width Change, per cent			Thickness Change, per cent		
	7 Days After Immersion ^b	7 Days After Removal	28 Days After Removal	7 Days After Immersion ^b	7 Days After Removal	28 Days After Removal	7 Days After Immersion ^b	7 Days After Removal	28 Days After Removal	7 Days After Immersion ^b	7 Days After Removal	28 Days After Removal
1. Grade X laminate...	13	3.8	1.9	0.2	0.1	0.1	0.8	0.4	0.1	15	5.2	3.4
2. Grade C laminate...	6.7	3.9	2.2	0.3	0.5	0.2	1.9	0.7	0.4	4.0	2.9	2.1
3. Grade C laminate...	5.9	3.9	2.7	0.3	0.1	0.0	0.9	0.7	0.5	2.8	2.1	2.0
4. Post-forming laminate	8.2	2.5	1.4	0.6	0.3	0.2	1.0	0.4	0.1	6.0	5.4	4.7
5. Grade AA laminate...	18	6.6	2.7	0.3	-0.3	-1.1	1.8	1.1	0.7	34	38	37
6. Urea molded, cellulose filler...	S ^a	S	S	S	S	S	S	S	S	S	S	S
7. Melamine molded, cellulose filler...	D ^a	D	D	D	D	D	D	D	D	D	D	D
8. Melamine molded, asbestos filler...	28	10	7.4	D	D	D	D	D	D	D	D	D
9. Polyvinyl chloride acetate...	0.3	0.2	-0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.4	1.0	0.7
10. Polyester-glass laminate...	1.8	-30	-32	-2.5	-4.2	-4.3	-5.9	-3.6	-4.3	30	36	30
11. Polymethyl methacrylate...	2.6	20	15	2.4	2.4	1.0	2.3	3.0	2.6	5.2	17	16
12. Polystyrene...	-0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.2
13. Polyethylene...	0.0	0.0	1.5	0.1	0.0	0.0	0.0	0.0	0.1	-9.6	-9.8	-8.6
14. Cellulose acetate, molded...	S	S	S	S	S	S	S	S	S	S	S	S

^a D = Specimen warped, disintegrated, or decomposed so that measurements were not possible. S = Soluble.

^b The specimens were conditioned for 24 hr. in air after removal from the 48 per cent hydrofluoric acid before these measurements were made.

the relative resistance of the materials to hydrofluoric acid reported here is useful.

MATERIALS AND TEST METHODS

The plastics examined were molded pieces of polyvinyl chloride acetate, polystyrene, polymethyl methacrylate, cellulose acetate, urea-formaldehyde, melamine-formaldehyde, and polyethylene plastics and pieces of phenolic paper, phenolic cotton-fabric, phenolic asbestos, and unsaturated-polyester glass-fabric laminates with machined edges. The test specimens were 1 by 3 in. The thicknesses and densities of the samples are given in Table I.

The specimens were conditioned at 25 C. and 50 per cent relative humidity for at least 14 days and then weighed and measured. The weighings were made on an analytical balance to the nearest milligram. The dimensions were measured with micrometers—the thickness to the nearest 0.0001 in. and the length and width to the nearest 0.001 in.

The specimens were placed on edge in large glass test tubes containing approximately 150 ml. of 48 per cent hydrofluoric acid. The inside of the test tubes was coated with ceresin wax to prevent the acid from attacking the glass. The cork stoppers were also coated with the wax. The tests were made in a well-ventilated hood at 20 to 30 C.

On removal from the solution of hydrofluoric acid, the specimens were rinsed with distilled water, wiped dry, and conditioned 24 hr. before they were weighed and measured. This washing and conditioning was necessary to avoid damaging the balance and the micrometers. Preliminary tests showed that when the specimens were removed, rinsed, wiped dry, and weighed immediately, sufficient hydrogen fluoride vapors were given off to damage the metal surfaces of the balance and micrometers.

Two specimens of each sample, after being weighed and measured, were immersed in the hydrofluoric acid for 7 days, removed, washed, conditioned for 1 day, and then weighed and measured. They were also weighed and measured 7 and 28 days, respectively, after removal from the acid. The results reported in Table II are the averages obtained with the two specimens. The agreement between specimens of the same samples was very good.

One specimen of each sample after being weighed and measured was immersed in the hydrofluoric acid for 1 day, removed, washed, conditioned for 1 day, and then weighed and measured. They were then immersed for 2 days for a total immersion period of 3 days, removed, washed, conditioned for 1 day,

and then weighed and measured. This process was repeated for additional immersion periods of 4 and 21 days for total immersion periods of 7 and 28 days, respectively. The results are reported in Table III.

The percentage changes in weights and dimensions reported in the tables are calculated on the basis of the initial weights and dimensions.

RESULTS AND DISCUSSION

The changes in weight and dimensions as a result of the immersion in hydrofluoric acid are presented in Tables II and III. The changes in appearance are reported in Table IV and shown in Fig. 1.

TABLE IV.—EFFECT OF IMMERSION OF PLASTICS IN 48 PER CENT HYDROFLUORIC ACID.

Sample Designation	Appearance After Immersion ^a
1.....	Darkened, delaminated
2.....	Darkened in spots
3.....	Lightened in spots
4.....	Warped slightly
5.....	Darkened, swollen, and cracked
6.....	Disintegrated, pink residue
7.....	Broken
8.....	Broken
9.....	Darkened, blistered, and white spots
10.....	Lightened, delaminated
11.....	Milky, swollen, and rubbery ^b
12.....	No noticeable effect
13.....	No noticeable effect
14.....	Soluble, pink solution

^a No appreciable differences were observed for periods of immersion of 1 to 28 days.
^b After drying, the rubberiness disappeared but the milkiness and swelling remained.

The results of the tests show that urea-formaldehyde and cellulose acetate plastics are soluble at room temperature in 48 per cent hydrofluoric acid. The phenolic laminate plastics containing cellulosic fillers were appreciably affected in less than a week; the one filled with asbestos was affected more than those filled with cellulosic materials. The melamine plastics are markedly affected. The resistance of the glass-fabric polyester plastic was less than that of the cellulose-filled phenolic plastics. The behavior of the polymethyl methacrylate plastic was peculiar; it became swollen, rubbery, and milky, and was still swollen and milky although no longer rubbery six months after removal from the acid solution. The resistance of polystyrene was outstanding. Polyethylene and vinyl chloride acetate plastics were affected only slightly although more so than polystyrene.

The 7-day and 28-day tests were made at different times. The differences in results observed with some samples are attributed to (1) difference in temperature and (2) the cyclic nature of one test contrasted with the continuous nature of the other. The tests could not be made in an air-conditioned constant temperature laboratory because of the hazard to personnel and equipment.

TABLE III.—CHANGES IN WEIGHT AND DIMENSIONS OF PLASTICS RESULTING FROM DISCONTINUOUS IMMERSION IN 48 PER CENT HYDROFLUORIC ACID.^{a, b}

Sample Designation	Weight Change After Immersion, per cent			Length Change After Immersion, per cent			Width Change After Immersion, per cent			Thickness Change After Immersion, per cent		
	1 Day	3 Days	7 Days	1 Day	3 Days	7 Days	1 Day	3 Days	7 Days	1 Day	3 Days	7 Days
1. Grade X laminate.....	1.9	4.0	-0.6	0.1	0.1	0.1	0.3	0.3	0.4	0.8	0.8	0.8
2. Grade C laminate.....	2.0	3.8	6.7	0.1	0.2	0.9	0.3	0.4	0.4	1.2	1.2	1.2
3. Grade B laminate.....	1.8	2.0	6.1	0.1	0.1	1.0	0.6	0.6	0.6	1.5	1.5	1.5
4. Polystyrene.....	4.2	5.1	4.2	-33	-33	-33	0.6	0.6	0.6	0.8	0.8	0.8
5. Grade AA laminate.....	3.6	0.3	7.5	0.2	0.4	0.4	1.3	1.3	1.3	1.8	1.8	1.8
6. Urea-molded cellulose filler	S ^b	S	S	S	S	S	S	S	S	S	S	S
7. Melamine molded, cellulose filler	D ^b	D	D	D	D	D	D	D	D	D	D	D
8. Melamine molded, asbestos filler	31	12	D	0.3	0.3	0.3	0.1	0.1	0.1	0.3	0.3	0.3
9. Polyvinyl chloride-acetate	0.2	0.2	D	0.2	0.2	0.2	0.4	0.4	0.4	0.2	0.2	0.2
10. Polyester-glass laminate.....	-1.8	-14	-39	0.2	0.6	0.0	1.6	1.6	1.6	170	283	283
11. Polymethyl methacrylate.....	13	22	28	0.6	0.0	0.0	0.0	0.0	0.0	108	63	63
12. Polystyrene.....	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.8	-8.0	1.6
13. Polyethylene.....	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	-0.2	-10	-18	-12
14. Cellulose acetate, molded.....	S	S	S	S	S	S	S	S	S	S	S	S

^a Specimens were immersed for 1 day, conditioned in air for 1 day, and measured; then immersed for 2 days, conditioned for 1 day, and measured; then immersed for 4 days, conditioned for 1 day, and measured; and finally immersed for 21 days, conditioned for 1 day, and measured.
^b D = Specimen warped, disintegrated, or decomposed so that measurements were not possible, S = Soluble.

A Suggested Relocation and Respacing of the Union Colorimeter Scale for Lubricating Oil and Petrolatum

By Deane B. Judd,¹ Lorenzo Plaza,¹ and Marion A. Belknap¹

Note.—A.S.T.M. Committee D-2, Research Division IX on Color (for several years) has been attempting to develop fundamental specifications for the A.S.T.M. Union Colorimeter. Inability to obtain glass standards that are reliably uniform in chromaticity has impeded this program. Because of this lack of uniformity there exists known measurable variations in the basic standards of various laboratories.

A new source of supply is now being developed, the main supplier being both willing and able to comply with tolerances that are being considered by Research Division IX.

Before the establishment of specifications, the study fully described in this article was conducted to measure the chromaticity of Petroleum Oils and to consider the possibility of chromatically respacing the standards so uniform color differences would exist between standards.—H. M. Hancock, Chairman Division IX.

SYNOPSIS

At the request of Research Division IX, A.S.T.M. Committee D-2 on Petroleum and Petroleum Products, a study of the chromaticities and daylight transmittances of petroleum products has been carried out. From the results of this study a recommended relocation of the A.S.T.M. Union colorimeter scale has been derived that is intended to minimize the difficulties frequently experienced in the color grading of "off-color" petroleum products. This study also revealed in some detail discrepancies in color grading between laboratories ascribable to failure of the glass color standards of the various Union colorimeters to conform to the master standards. It has been found possible to respace the color standards along the relocated locus by changes smaller than these interlaboratory discrepancies so as to yield uniform color steps as perceived by the eye under the conditions of observation prescribed by the Tentative Method of Test for Color of Lubricating Oil and Petrolatum by Means of A.S.T.M. Union Colorimeter (D 155-45 T).² This relocation and respacing of the Union colorimeter scale is presented as a suggestion for possible adoption by the industry.

SINCE 1923 it has been customary to measure and specify the color of lubricating oil and petrolatum by means of the A.S.T.M. Union colorimeter.² This colorimeter consists of an artificial daylight assembly with flashed-opal diffuse light transmitter, a jar of internal diameter between 32.5 and 33.4 mm. to hold the test sample, a series of 12 glass color standards ranging from pale greenish yellow to dark red and mounted in a vertical slide that may be raised or lowered to permit one or another of the standards to be viewed, a light shield to prevent extraneous light from falling on sample or standard, and an arrangement of partitions and diaphragms permitting the observer to view the color of the glass standard and the color of the test sample as filling two circles subtending at the eye of the observer about 2 deg. with their centers separated by about 6 deg., the surrounding field being dark. The glass color standards are combinations of Lovibond glasses obtained from Tintometer Ltd.

The spectral transmittances of the master standards for the Union color scale were determined at the National Bureau of Standards,³ and their lumi-

nous transmittances, T_0 , and chromaticity coordinates, x , y , were computed in accord with the ICI standard observer and coordinate system for colorimetry⁴ by Scofield, Judd, and Hunter.⁵ Table I repeats the Lovibond analysis of these master standards given in D 155-45 T,² and gives the luminous transmittances, and the chromaticity coordinates both on the ICI system (x , y) and on the uniform-chromaticity-scale (UCS) system (r , g).⁶

To determine the A.S.T.M. color number of an oil, the oil is put into the standard jar, and the jar is placed in the right-hand compartment. In the other compartment is placed a 4-oz. sample bottle of distilled water. The jar and bottle are covered with the light shield, and the artificial daylight lamp is lighted. The color of the oil is obtained

by determining the glass color standard which most nearly matches the color of the oil under examination. The colors of oils which are intermediate to the standard colors are expressed in terms of the darker as "lighter than" or "minus." For example, an oil that has a color between 7 and 8 is expressed as "lighter than 8" or "8 minus." In determining the darker colors the daylight lamp is sometimes moved closer to the opal-glass diffuser.

For many oils the Union colorimeter is quite satisfactory. The results are obtained rapidly, and one observer can repeat his own results or those of another observer without trouble. This indicates that the glass color standards have been chosen with some care so as to cover the color range of these oils with good precision. Other oils, however, depart considerably from the locus of colors defined by the 12 standards of the Union color scale. For such oils the observer finds that none of the standards yields a color match, nor does it seem to him that the oil color is intermediate between any two of the standard colors.

Committee Deliberations on Relocation:

Color is a three-dimensional quantity; it requires for its specification at least three independent scales. The simplicity of the Union color scale is based upon the fact that it describes a one-dimensional variation. That is, the Union color scale corresponds to a single (non-planar, curved) line in the color solid, and it serves well for those colors represented on (or near) that one line. Relocation of the one-dimensional color scale cannot make it applicable to all oils, but by choosing color standards that correspond to the average color of oils it is possible to minimize the difficulties introduced by off-color oils.

Another source of error in grading oils by A.S.T.M. Method D 155-45 T arises from the difficulty of obtaining precise duplicates of the master stand-

¹ Report of National Bureau of Standards, Test No. 57968, issued December 18, 1929, to A.S.T.M. Committee D-2 on Petroleum Products and Lubricants.

² Proceedings, Eighth Session, Commission Internationale de l'Eclairage, Cambridge, England, September, 1931, pp. 19-29; also A. C. Hardy, Handbook of Colorimetry, Cambridge, Technology Press, 1936; also D. B. Judd, "The 1931 ICI Standard Observer and Coordinate System for Colorimetry," *Journal, Optical Soc. Am.*, Vol. 23, p. 359 (1933).

³ F. Scofield, D. B. Judd, and R. S. Hunter, "A Proposed Method of Designating Color," *ASTM BULLETIN*, No. 110, May, 1947, p. 19.

⁴ D. B. Judd, "A Maxwell Triangle Yielding Uniform Chromaticity Scales," *Journal Research, Nat. Bureau Standards*, Vol. 14, p. 41 (1935); *Journal, Optical Soc. Am.*, Vol. 25, p. 24 (1935).

⁵ National Bureau of Standards, Washington, D. C.

⁶ 1949 Book of A.S.T.M. Standards, Part 5, p. 780.

TABLE I.—COLORIMETRIC SPECIFICATIONS OF THE 12 GLASSES COMPRISING THE UNION COLOR SCALE; ILLUMINANT: ICI STANDARD C (AVERAGE DAYLIGHT).

A.S.T.M Color Numbers	Lovibond Analysis			Luminous Trans- mittance, T_0	Chromaticity Coordinates			
	Red	Yellow	Blue		ICI system		UCS system	
					x	y	r	g
1.....	0.12	2.4	...	0.751	0.3488	0.3815	0.462	0.476
1½.....	0.60	8.0	...	0.654	0.3995	0.4460	0.491	0.477
2.....	2.5	26.0	...	0.443	0.4724	0.4765	0.542	0.448
2½.....	4.6	27.0	...	0.365	0.4985	0.4570	0.570	0.421
3.....	6.9	32.0	...	0.287	0.5252	0.4402	0.600	0.393
3½.....	9.4	45.0	...	0.211	0.5561	0.4234	0.636	0.360
4.....	14.0	50.0	0.55	0.096	0.5908	0.3995	0.683	0.315
4½.....	21.0	56.0	0.55	0.065	0.6199	0.3758	0.729	0.270
5.....	35.0	93.0	...	0.036	0.6528	0.3467	0.789	0.210
6.....	60.0	60.0	0.55	0.017	0.6764	0.3234	0.841	0.159
7.....	60.0	106.0	1.8	0.0066	0.6841	0.3155	0.860	0.140
8.....	166.0	64.0	...	0.0020	0.7140	0.2860	0.938	0.062

ards of the Union color scale. At its Detroit meeting in June 1948, Subcommittee VI on Color, A.S.T.M. Committee D-2 on Petroleum Products, decided to cooperate with the C. J. Tagliabue Manufacturing Co., maker of the A.S.T.M. Union colorimeter, in an attempt to make possible the procurement of color standards from an American source of supply, procurement of satisfactory duplicates from the present foreign source of supply (Tintometer, Ltd., Salisbury, England) having become increasingly difficult, due primarily to shortage in the supply of Lovibond glasses. It was proposed first that the master standards, or duplicates of certain of them that have become scratched or chipped, be submitted to the Corning Glass Works as a guide in the preparation of a set of glasses that should give a visual match for the colors of the master standards. Second, it was proposed that these matching color glasses be submitted to a referee laboratory, such as the National Bureau of Standards, so that their spectral transmittances might be determined and the luminous transmittances and chromaticity coordinates for illuminant C calculated. Third, it was suggested that tolerances in the procurement of duplicates from Corning Glass Works be set at ± 0.006 in chromaticity coordinates (r, g, b) on the uniform chromaticity scale system and either at ± 10 per cent of the luminous transmittance or at 10 per cent for the darker glasses with smaller tolerances on a sliding scale for the lighter glasses, the differences between the approved matching color glasses and the duplicates to be evaluated by visual colorimetry.

Following the Detroit meeting, a summary of available colorimetric data (transmittance and chromaticity coordinates on the uniform chromaticity scale system) of the master standards and certain approximate duplicates of them prepared before 1939 by the Jena Glass Works of Germany was drawn up by H. M. Hancock, Chairman, and circulated on October 11, 1948, to the members of the subcommittee. This summary included remarks on the goodness

of match judged by visual comparison of the Jena approximate duplicates with the respective master standards. This comparison corroborated the proposed tolerance on chromaticity coordinates (r, g, b) of ± 0.006 and suggested that the transmittance tolerance be set at ± 10 per cent for the darkest glass (Union No. 8) and progressively reduced to about ± 4 per cent for the lightest (Union No. 1).

On November 5, 1948, a meeting of representatives of the C. J. Tagliabue Co., the Weston Electric Instrument Co., the Corning Glass Works, and Subcommittee VI, A.S.T.M. Committee D-2, was held to discuss feasibility of procuring from Corning Glass Works duplicates of the master standards within these suggested tolerances. The representative of the Corning Glass Works (Mr. A. J. Werner) reported that the present glasses available through Corning would permit two-component combinations, one component being amethyst glass, to be made that would satisfy the tolerances above Union No. 3½, but that those below 3½ exhibited a consistent shift toward yellow. A number of sets of these glasses have been made up and sold. Mr. Werner agreed to investigate the possibility of using a different combination of glasses that would satisfy the tolerances for glasses below 3½ also.

Following this preliminary meeting, the November, 1948, meeting of Subcommittee VI was held in Chicago. It was pointed out in discussion of Mr. Werner's difficulty with glasses to duplicate the lighter standards (less than 3½) that measurements of 22 petroleum products by Diller, De Gray, and Wilson⁷ indicated that they departed from the Union locus in the same range and direction. It was voted that the subcommittee undertake to determine the average colors of oils in the range of Union 1 to 3½ based upon a more adequate sampling than is afforded by the 22 products measured by Diller, De

⁷ I. M. Diller, R. J. De Gray, and J. W. Wilson, Jr., "Photoelectric Color, Description, and Mensuration of the Color of Petroleum Products," *Industrial and Engineering Chemistry*, Vol. 14, p. 607 (1942).

Gray, and Wilson. Accordingly the various members of the subcommittee submitted representative samples of finished and processed petroleum products up to and including Union No. 3½ to H. M. Hancock, chairman. A selection of 49 representative samples of this group of petroleum products was then made and the 49 samples were sent to the National Bureau of Standards for measurement of luminous transmittance and chromaticity coordinates.

One purpose of this paper is to give the method and results of these measurements, and to recommend a relocation of the Union color scale based upon them.

Committee Deliberations on Respacing:

At the Chicago meeting, the question of whether the present spacing of the color standards of the Union scale ought to be duplicated was also raised. It was pointed out that the scale proceeds by half steps up to 5, then by whole steps up to 8. Furthermore, the perceptual difference between Union No. 6 and 7 is much smaller than that between 7 and 8. This is shown by the spectrophotometric determinations (see Table I, $r_6 = 0.841$, $r_7 = 0.860$, $r_8 = 0.938$), and by visual inspection of the master standards. Would it not be better, it was argued, if we are going to relocate the Union locus anyway, to request Corning Glass Works to supply duplicates of a master set of standards having as close an approximation as is possible to uniform perceptual spacing? Is it not foolish to reproduce with great care all of the defects of a choice of color scale made in 1923? Some members of the subcommittee viewed with discomfort the prospect of changing the meaning of the various Union numbers. This would cause confusion between the old and the new meanings, and would give rise to disputes and dislocations of present practice in writing purchase specifications of petroleum products, they thought. It was pointed out by Mr. Hancock, however, that a great improvement in uniformity of spacing could be achieved by making changes that would be less than the spread between color standards of the same Union color number in the different colorimeters now in use. He presented two tentative suggestions, one at the meeting, one soon after, in a letter of November 24, 1948, showing that only relatively small changes might be required. Table II gives these tentative suggestions in terms of the r -coordinate of the Union color scale system.

It may be seen from Table II that the chromaticity spacing ($\Delta r/\Delta N$) of the revisions suggested by Mr. Hancock is indeed much more constant than that of

TABLE II.—SUGGESTIONS FOR RESPACING OF THE UNION COLOR SCALE.

Union Standard			Suggestion at Chicago Meeting			Suggestion of November 24, 1948		
N	r	$\frac{\Delta r}{\Delta N}$	r	$\frac{\Delta r}{\Delta N}$	Equivalent on Present Union Scale	r	$\frac{\Delta r}{\Delta N}$	Equivalent on Present Union Scale
2.....	0.542	0.056	0.528	0.072	1.8	0.542	0.068	2.0
2.5....	0.570	0.060	0.564	0.072	2.4	0.576	0.076	2.6
3.....	0.600	0.072	0.600	0.072	3.0	0.614	0.066	3.2
3.5....	0.636	0.094	0.636	0.062	3.5	0.647	0.072	3.6
4.....	0.683	0.092	0.667	0.080	3.8	0.683	0.064	4.0
4.5....	0.729	0.120	0.707	0.064	4.2	0.715	0.068	4.3
5.....	0.789	0.052	0.739	0.067	4.6	0.749	0.067	4.7
6.....	0.841	0.019	0.806	0.068	5.3	0.816	0.068	5.5
7.....	0.860	0.078	0.874	0.064	7.2	0.884	0.070	7.3
8.....	0.938		0.938		8.0	0.954		8.2

the present Union scale. The variation in step size has been reduced from 0.100 in the Union scale to 0.018 in the Chicago suggestion and to 0.012 in the suggestion of November 24. These marked improvements in chromaticity spacing have been obtained by shifts that average about 0.2 of a step in the Union scale. In criticism of Mr. Hancock's suggestions, however, it was remarked at the Chicago meeting that the perceptual size of the steps in the color scale might not be correctly indicated by spacing of the *r*-coordinate of the colors. The uniform chromaticity scale system gives a close approach to uniform chromaticity spacing only provided the luminance of the fields being compared remains substantially at the same level. Since the luminous transmittance of the standards varies from 75 per cent down to 0.2 per cent, there is some question whether there is enough light available to permit the eye to distinguish the chromaticity differences between the darker members of the set of color standards with as much facility as those between the lighter members. Since the method permits moving the daylight lamp closer to the diffuser for the darker colors, it would seem that a lack of sufficient light is to be admitted and that some account should be taken of the luminance of the fields being compared by spacing out the darker members of the color scale more than would be indicated by a uniform spacing of chromaticity alone.

Another possibility that ought to be taken into account is the fact that the members of each pair of neighboring color standards in the set differ appreciably in luminous transmittance. Although the separation of the two fields to be compared by a sizable dark area tends to obscure the luminance difference between them, it is possible that the perceptual size of the step depends appreciably on the luminance difference as well as the chromaticity difference.

It was agreed at the Chicago meeting

that suitable account should be taken of these two factors, and one of the authors (Judd) was requested to derive a respacing of the Union scale that should appear uniform under the conditions of viewing embodied in the A.S.T.M. Union colorimeter.

It is the second purpose of this paper to give the results of the derivation made.

mittance by means of a photoelectric colorimeter with tristimulus filters⁸ belonging to the Henry A. Gardner Laboratory. This colorimeter is designed especially for the measurement of liquids in cylindrical cells and permitted the making of measurements of the samples without removing them from the sample bottles which conform closely to the requirements of A.S.T.M. Method D 155 - 45 T for the standard jar. Thanks are due to Mr. R. S. Hunter of the Henry A. Gardner Laboratory for his courtesy in permitting us to bring the oil samples to his laboratory for these measurements.

The standards and methods used are described in detail in the complete account of this work scheduled to appear in the June, 1950, issue of the Journal of Research of the National Bureau of Standards. From the agreement between results obtained by means of different standards, it is estimated that the values of chromaticity coordinates (*x*, *y*) are uncertain by not more than ± 0.005 . Figure 1 is a portion of the (*x*, *y*)-chromaticity diagram showing

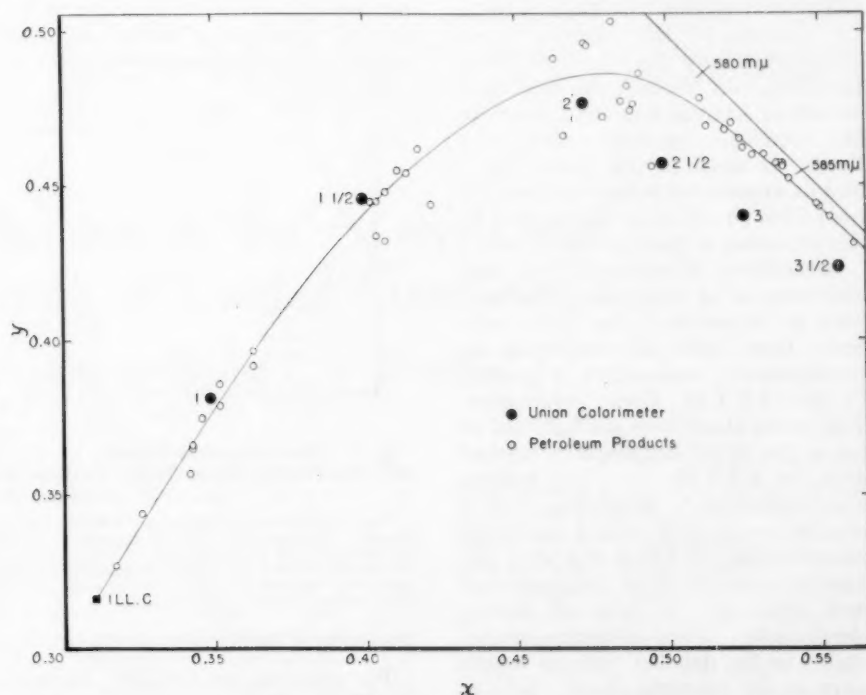


Fig. 1.—Comparison of the Chromaticities of the Union Colorimeter Standards with Those of Representative Petroleum Products Collected by Subcommittee VI (now Research Division IX), A.S.T.M. Committee D-2.

The curved line on this (*x*, *y*)-chromaticity diagram, running from the point representing illuminant C (average daylight) to a region near the spectrum locus at 585 mμ and beyond, corresponds closely to the average of these petroleum products, and is recommended as a relocation of the Union colorimeter scale.

Measurement of Luminous Transmittance, *T*, and Chromaticity Coordinates (*x*, *y*), of 49 Samples of Petroleum Products:

Each of the 49 samples was compared by the substitution method with two glass standards of known spectral trans-

how the chromaticity coordinates of these oils compare with the master standards of the Union color scale. The curve is the recommended relocation of

⁸ R. S. Hunter, "Photoelectric Tristimulus Colorimetry with Three Filters," National Bureau of Standards, Circular C429, July 30, 1942.

TABLE III.—INTERLABORATORY COMPARISON OF GRADING BY THE A.S.T.M. UNION COLORIMETER

A.S.T.M. Union Number Reported by Refiner	A.S.T.M. Number Reported by the Laboratory of the Refiner minus the A.S.T.M. Number Obtained in the Present Test					
	Lab. A	Lab. B	Lab. C	Lab. D	Lab. E	Lab. F
$\frac{1}{4}$	0.0					
1 Lt (= 0.8).....						
1.....		0.0	+0.3	0.0 -0.1	+0.4	+0.2
1 Dk (= 1.2).....					{+0.4 +0.3}	
$1\frac{1}{4}$	-0.2			-0.1 -0.1 -0.1		
$1\frac{1}{2}$	-0.5	0.0	0.0			0.0
$1\frac{1}{2}$ Dk (= 1.7)....	-0.3				+0.1	
2.....		-0.1	+0.1	-0.2 -0.2 -0.2		0.0
2 Dk (= 2.2).....					+0.2	
$2\frac{1}{4}$ Lt (= 2.3).....					+0.1	
$2\frac{1}{4}$	-0.2 -0.5	-0.1 0.0		-0.3 -0.4 -0.2		-0.5
$2\frac{1}{4}$ Dk (= 2.7)....					+0.2	
$2\frac{3}{4}$	-0.2				+0.1	
3 Lt (= 2.8).....		0.0		-0.2		
3.....		0.0		-0.3 -0.5		0.0
$3\frac{1}{4}$	-0.7				+0.3	
$3\frac{1}{2}$						
Average	-0.3	0.0	+0.1	-0.2	+0.2	-0.1

the Union color scale; it is intended to be a smooth average of the chromaticity variation shown by the petroleum products. Note that with three exceptions all of the oil samples between Union 2 and $3\frac{1}{2}$ deviate from the Union locus in the direction of the spectrum locus. This corroborates the report by Diller, De Gray, and Wilson⁷ although these deviations average less than those for the petroleum products studied by them. It would appear from Fig. 1 that an appreciable reduction of trouble from off-color oils is to be obtained by this relocation of the Union color scale.

In addition to accomplishing their chief purpose of supplying information basic to relocation of the Union color scale, these data also constitute an interlaboratory comparison of grading by the A.S.T.M. Union colorimeter. This comes about from the fact that 46 out of the 49 oil samples were marked with the A.S.T.M. (or NPA) number when submitted.⁸ From Fig. 1 it is possible to estimate with a maximum uncertainty of 0.2 Union step what this number would be if the judgment had been made on the basis of nearest chromaticity. These estimates are included in the detailed table of results given in the complete paper. On the average, the A.S.T.M. number reported by the refiner was found to agree closely with those indicated by this colorimetric study. However, one oil ($3\frac{1}{4}$) was graded lower by 0.7 than our measurements (4.0) would place it, and another similar oil ($3\frac{1}{2}$) was graded higher by 0.3. This suggests that there is a serious discrepancy between the Union $3\frac{1}{2}$ glasses used in the two laboratories.

⁸ Acknowledgment with thanks is due to the following laboratories supplying these data: Shell Development Co., Atlantic Refining Co., Socony-Vacuum Oil Company, Inc., Sun Oil Co., Esso Standard Oil Co., and Phillips Petroleum Co.

Table III gives a breakdown of this sort of difference according to laboratory. It will be noted that there is a remarkably consistent tendency for one laboratory to read high by about 0.2, for two laboratories to read low by 0.2 and 0.3, respectively, and for one laboratory to yield agreement with the present results.

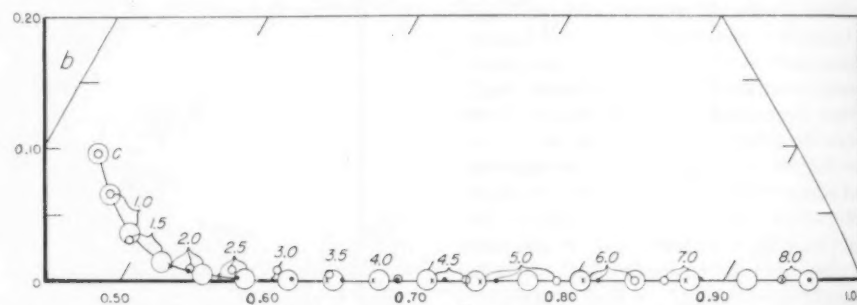


Fig. 2.—Recommended Spacing of the Union Color Scale (large circles) Compared with the Present Union Scale (small circles) and with Two Suggestions for respacing by H. M. Hancock (dots and crosses).

The UCS chromaticity diagram, formed by plotting at 60 deg. the *b*-coordinate against the *r*-coordinate, is used. Uniform steps on this diagram are known to correspond to a good approximation to chromaticity scales that are perceptually uniform at constant luminance. Note that the darker colors (5 to 8) of the recommended spacing are spaced out more than the lighter colors (1 to 4). Note also the good agreement between the recommended scale derived by formula and the two suggestions made by Hancock from practical considerations alone.

Respacing of the Union Color Scale:

By reference to A.S.T.M. Method D 155 - 45 T² it may be seen that the observer views two circular spots of color ($\frac{9}{16}$ in. in diameter at a distance of 15 in.) subtending about 2 deg. at his eye with their centers separated by about 6 deg., both surrounded by a dark field. The light source (60-w. bulb of about 13 lumens per watt) supplies a luminous flux of 780 lumens nearly all of which, because of the reflector, is fairly uniformly distributed over the hemisphere, viewed toward the opal-glass diffuser, except that there is a bright spot corresponding to the lamp filament located

close to the axis of the instrument. The portion of the diffuser viewed in either of the observing fields subtends at a distance of 4 in. about one-twentieth of the hemisphere. The useful light flux striking the diffuser is about 60 lumens. This flux would light up a perfectly transmitting, perfectly diffusing plate to a luminance (photometric brightness) of about 45 footlamberts. Counting the transmittance of the flashed-opal diffuser as 30 per cent, and the transmittance of the daylight filter as 16 per cent, we find the luminance of the field without any oil sample or glass color standard interposed to be about 2 footlamberts. This is about double the least luminance required to permit the eye to detect chromaticity differences with an approach to maximum efficiency; so it may be concluded that the lighting unit is all that could be asked for if used for samples that transmit more than 50 per cent (Union No. 2 and lower), but that darker samples would be more easily distinguished in chromaticity if more light were provided.

Accordingly we have derived a spacing of colors along the relocated locus so as to allow progressively larger chromaticity steps for the darker colors. This spacing like those proposed by Mr.

Hancock (see Table II) is based upon the uniform chromaticity scale system.⁶ Details of the derivation of this spacing and its check to show that it conforms to the intended conditions are given in the complete account scheduled for publication in the June issue of the Journal of Research of the National Bureau of Standards. Figure 2 shows the chromaticities of this recommended relocation and respacing of the Union color scale on the Union color scale triangle and compares it with the present scale and with Mr. Hancock's two suggestions (see Table II). The open circles defining the chromaticities of the recom-

TABLE IV.—RECOMMENDED COLOR SPECIFICATIONS AND TOLERANCES FOR 17 GLASS COLOR STANDARD NUMBERS COMPRISING A RELOCATION AND RESPACING OF THE A.S.T.M. UNION COLOR SCALE.

Number ¹	Chromaticity Coordinates ^a (UCS System ²)			Luminous Transmittance (ICI Standard Source C), T	
	r	g	b		
0.0.....	0.439	0.465	0.096	0.92	± 0.03
0.5.....	0.462	0.473	0.065	0.86	± 0.03
1.0.....	0.489	0.475	0.036	0.77	± 0.03
1.5.....	0.521	0.464	0.015	0.67	± 0.03
2.0.....	0.552	0.442	0.006	0.55	± 0.03
2.5.....	0.582	0.416	0.002	0.44	± 0.02
3.0.....	0.611	0.388	0.001	0.31	± 0.02
3.5.....	0.640	0.359	0.001	0.22	± 0.02
4.0.....	0.671	0.328	0.001	0.152	± 0.011
4.5.....	0.703	0.296	0.001	0.109	± 0.008
5.0.....	0.736	0.264	0.000	0.081	± 0.006
5.5.....	0.770	0.230	0.000	0.058	± 0.005
6.0.....	0.805	0.195	0.000	0.040	± 0.004
6.5.....	0.841	0.159	0.000	0.026	± 0.003
7.0.....	0.877	0.123	0.000	0.016	± 0.002
7.5.....	0.915	0.085	0.000	0.0081	± 0.0008
8.0.....	0.956	0.044	0.000	0.0025	± 0.0003

^a Tolerances on the chromaticity coordinates (r, g, b) are ±0.006.

mended standards have radii of 0.006 so as to indicate the proposed tolerances.

It will be noted from Fig. 2 that the chromaticity spacing of the recommended scale increases regularly from the light colors to the dark, the total increase in spacing being about 50 per cent. This increase in spacing corresponds to the added difficulty of discriminating among the darker colors viewed under the conditions of the A.S.T.M. Union colorimeter. The recommended tolerances of ±0.006 cor-

respond to about 0.1 step in the respacing of the Union color scale. The relocation of the scale is seen from Fig. 2 to amount in maximum also to 0.006 in r, g, or b.

Figure 2 also shows that the recommended scale corresponds within the tolerance of ±0.006 either to Mr. Hancock's Chicago suggestion or to his suggestion of November 24, 1948, with the single exception of the No. 2 standard. Since practical considerations led Mr. Hancock to such a close correspondence

with our best determination of a perfectly uniform scale, it is to be presumed that this recommendation is worthy of adoption by industry.

There remains, of course, the important question whether industry will become reconciled to any change in definition of the Union scale at all. Perhaps it would avoid confusion if the recommended scale be given a new name and a different number of steps. If such a procedure is decided upon, the method used by us is recommended for development of specifications for standard glasses unless an important change in viewing conditions is also made.

Summary:

In response to a request from Subcommittee VI on Color, of A.S.T.M. Committee D-2 on Petroleum Products, a study of the colors of typical petroleum products supplied by members of the subcommittee has been carried out and a relocation and respacing of the Union color scale has been derived from these measurements and from an analysis of the viewing conditions of the A.S.T.M. Union colorimeter used in accord with A.S.T.M. Method D 155 - 45 T. The recommended colors and tolerances for 17 glass color standards are given in Table IV.

X-Ray Methods in the Analysis and Preparation of Leaded Gasoline¹

By H. A. Liebhafsky and E. H. Winslow²

SYNOPSIS

Various ways are open for the determination of tetraethyllead fluid in leaded gasoline by methods involving the absorption of X-rays. Experimental results are given only for the determination based upon the absorption of polychromatic X-rays by the sample, the intensity of the emergent beam being measured by a photoelectric detector consisting of a phosphor and a multiplier phototube.

With the parent base stocks available as standards for comparison with leaded gasolines, the laboratory photometer has given tetraethyllead fluid contents comparable in accuracy and precision with those obtained chemically by the Ethyl Corp. For this problem, the X-ray method warrants being recommended as time-saving and convenient.

When the parent base stock is unavailable and unknown, this determination of tetraethyllead fluid becomes complicated, owing mainly to the possible presence of sulfur in unknown amount. Under these conditions, it is generally unsafe to rely completely upon a single absorbance measurement in the analysis for tetraethyllead fluid. By making such measurements on two properly chosen polychromatic beams, however, it has been possible to determine both tetraethyllead fluid and sulfur reasonably well on samples again provided by the Ethyl Corp.

A brief description is given of a proposal by J. P. Smith, in which the automatic blending of base stock and tetraethyllead fluid is controlled by the General Electric X-ray photometer.

AN ATTEMPT will be made here to give a brief survey of the application of methods based on X-ray absorption to the problem of preparing and analyzing leaded gasoline. Technical details relating to the nature and detection of X-rays will not be emphasized nor will extensive references be given. The reader interested in such matters is requested to consult the two annual reviews in *Analytical Chemistry* (1, 2)³ on X-ray absorption and related subjects.

Analytical methods based upon X-ray absorption are not at their best in the quantitative determination of constituents present in concentrations (for instance 0.1 per cent by weight) com-

¹ Presented at a Symposium on Tetraethyllead and Gasoline held at a meeting of A.S.T.M. Committee D-2 on Petroleum Products and Lubricants, February 21, 1950, Washington, D. C.

² Research Laboratory, General Electric Co., Schenectady, N. Y.

³ The boldface numbers in parentheses refer to the list of references appended to this paper.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or the attention of the author. Address all communications to the A.S.T.M. Headquarters 1916 Race St., Philadelphia 3, Pa.

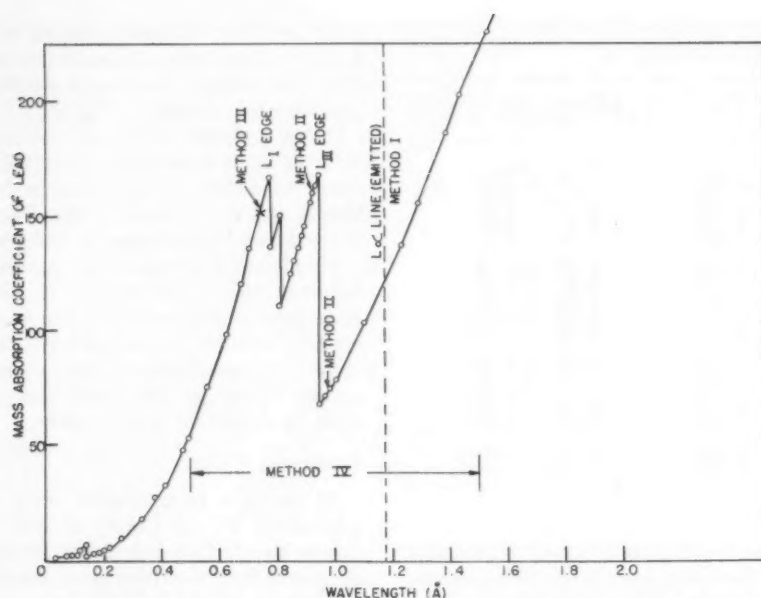


Fig. 1.—Relationship of Various Analytical Methods to Fundamental X-Ray Data for Lead.

NOTE 1.—In method I, energy of wave lengths below, say, 1 Å excites the L line, whose intensity is measured.

NOTE 2.—In method II, absorptometric data are taken at wave lengths above and below an absorption edge. Extrapolation to the edge gives the change in absorbance from which the amount of the corresponding element is calculated. Note that several absorbance measurements are necessary. An interesting modification of this method (7) requires only two absorbance measurements and thus resembles more closely the differential absorbance method for polychromatic beams developed in this paper.

NOTE 3.—In method III, an absorbance measurement is made at a single wave length, preferably one somewhat shorter than an absorption edge. Note that every element, free or combined, in a sample will absorb X-rays, which keeps the method from being specific.

NOTE 4.—In method IV, an absorbance measurement is made by use of a beam containing a considerable range of wave lengths. The polychromatic character of the beam can cause complications. The second sentence describing method III applies here.

TABLE I.—INCOMPLETE CHARACTERIZATION OF X-RAY METHODS.

Method	Name	Type	Specific	Measured Intensity	Preferred Detector	Extreme Voltage Stabilization	Adaptability to Control in Plant
I.....	X-ray Fluorescence	Spectrophotometric	Yes	Low	Geiger counter	Desirable	Possibly
II.....	Absorption-edge	Spectrophotometric	Yes	Low	Geiger counter	Desirable	Possibly
III.....	Absorptometry (monochromatic)	Spectrophotometric	No	Low	Geiger counter	Desirable	Possibly
IV.....	Absorptometry (polychromatic)	Photometric	No	Can be high	Multiplier phototube	Sometimes mandatory	Definitely

parable with that of tetraethyllead fluid in gasoline. But this analysis of leaded gasoline is important, and the potential advantages offered by X-ray methods are great. Consequently, a thorough reappraisal of the situation is warranted whenever the means of detecting X-rays are improved, as they have been in the last decade.

During the past several years, the Ethyl Corp. has kindly discussed with the authors the determination of tetraethyllead fluid by absorbance measurements on monochromatic and polychromatic beams, and has furnished samples for test. In this work, a beam containing X-rays of many wave lengths passes through the sample and then strikes a phosphor that converts it to visible light which is changed into an electric current by a multiplier phototube. To show the relation of this to other methods based upon X-ray absorption, it seems advisable to review briefly four such methods.

Of these four methods, three are

truly absorptometric and the other—the method of X-ray fluorescence—depends upon absorbed X-rays to excite the emitted line whose intensity is measured. An adequate discussion of the methods cannot be given here nor can all possible modifications thereof be mentioned. Each method has advantages and disadvantages, the more important of which will be clear from an examination of Fig. 1 and Table I. Probably no method can be singled out as best for all analytical and control problems.

ABSORPTOMETRY WITH POLYCHROMATIC BEAMS

Apparatus.—It has already been mentioned that a polychromatic X-ray beam can be converted into an electric current by means of a phosphor and multiplier phototube. This current can be amplified further outside the phototube to become the output current, i , proportional in magnitude to the intensity, I , of the X-ray beam striking

the detector. Ammeter readings can thus be made to measure the extent to which a sample placed in an X-ray beam reduces the intensity (or power) of the beam.

All measurements reported were made on a laboratory photometer, which has been described elsewhere (1). The weighed samples were contained in aluminum cells covered with aluminum foil, and volatility losses during the determination were negligible.

Comparative Method.—Inasmuch as the absorption of X-rays follows the usual exponential law, we may write

$$\log(I_0/I) = \log(i_0/i) = k(m) = \mu_m m/2.303a \dots \dots \dots (1)$$

as the fundamental law for the laboratory photometer under the simplest conditions. In this equation, I_0 and I are the intensities of the X-ray beam on entering and on leaving the sample of mass m grams, i_0 and i are the corresponding output currents, μ_m is the mass absorption coefficient, and a is the area of the sample in square centimeters.

Equation 1 can lead to complexities, especially when polychromatic beams are used (1). These complexities can always

be made less serious, and often eliminated, if the comparative method is adopted so that the interpretation of the experimental results no longer involves directly the output currents (3). In this method, the comparison is accomplished by commuting—as rapidly as is convenient—in the X-ray beam between an unknown and a suitable standard. A standard approaching the unknown in mass and in ultimate composition is always suitable, but substances not meeting this requirement may often be used (see below).

For the comparative method at complete balance, Eq. 1 may be written

$$\log i^U - \log i^S = k^S m^S - k^U m^U = 0 \dots \dots \dots (2)$$

where superscripts S and U refer to standard and unknown.

As Table II shows, the output currents are so nearly identical in the present method that values of $k^S m^S$ and $k^U m^U$ for which they are identical can be calculated with high precision.

TABLE II.—DETAILED DATA FOR COMPARISON OF TETRAETHYLLEAD FLUID IN ISOCTANE WITH ISOCTANE.

(a) AUXILIARY DATA
 Samples: Cell A, 8.964 g. isooctane. Cell B, 8.967 g. isooctane solution containing 1.979 ml. tetraethyllead fluid per gal.
 Cell Correction: Cell B = Cell A + 0.35 mil aluminum. (Determined under the experimental conditions with equal weights of the same isooctane-tetraethyllead fluid solution in each cell.) Cells covered with 1-mil aluminum foil.
 Settings: X-ray tube primary voltage, 100 v. (42.2 kv. peak); filament current, 10 ma.; detector voltage, 50 v. per stage.
 Amplification: Output current $\times 10^{-2}$ = output current in milliamperes.

(b) DETAILED OUTPUT CURRENT READINGS			
Cell B	Cell A + 9 mils Aluminum	Cell B	Cell A + 8 mils Aluminum
69.5..	68.4	68.4	69.5
71.3..	69.5	70.4	69.9
71.1..	69.0	70.5	70.3
71.4..	69.6	70.5	70.3
71.5..	69.1	70.5	70.4
70.5..	68.5	70.5	70.2
70.5..	68.3	70.0	69.2
68.5..	67.5	69.2	68.5
70.2..	67.5	68.7	68.6
70.5..	67.5	69.4	69.5
Av. 70.50.	68.49	69.81	69.64

(c) CALCULATIONS
 By logarithmic computation (see Eq. 1), Cell B = Cell A + 7.91 mils aluminum.
 Cell correction applied, Cell B = Cell A + 7.56 mils aluminum.

For these values, Eq. 2 becomes

$$k^S m^S = k^U m^U \dots (2a)$$

The comparative method is wholly reliable only if deviations from the relation

$$k_1^S m_1^S / k_2^S m_2^S = k_1^U m_1^U / k_2^U m_2^U \dots (3)$$

are not great enough to affect the analytical results. (In Eq. 3, the subscripts refer to any two determinations on the same substance.) Whether this is true can easily be established from data obtained on samples of known composition, as will now be shown.

Although individual situations differ, the comparative method usually gives the composition of the unknown in terms of a standard. Take now an isooctane solution containing tetraethyllead fluid in known amount and bring it into balance with a composite standard consisting of an equal mass of isooctane upon which is laid enough aluminum foil (say, a thickness of t mils; see Table II). It is then convenient to regard the tetraethyllead fluid present as equivalent to t mils of aluminum; whence, according to Eq. 2a

$$k^S/k^U = \text{tetraethyllead fluid (milliliters per gallon)} / t \text{ (mils aluminum)} \dots (2b)$$

By repeating the measurements at different concentrations of tetraethyl-

TABLE III.—TETRAETHYLLEAD FLUID IN LEADED GASOLINE, ALUMINUM AS STANDARD.

Sample	Equivalent Thickness, y , mils of Aluminum		Tetraethyllead Fluid, x , ml. per gal.	
	Observed	Calculated	Chemical	X-ray
AOT-1.....	150.2	150.2	0	0.0 ₀
AOT-2.....	163.6	163.6	0.9 ₂	0.9 ₂
AOT-3.....	175.2	175.2	1.7 ₂	1.7 ₂
AOT-4.....	191.6	191.6	2.8 ₄	2.8 ₄
Experimental Equation: $y = 150.2 + 14.56x$				
AIT-1.....	167.6	167.5	0.8 ₁	0.8 ₂
AIT-2.....	188.8	188.8	1.8 ₁	1.8 ₁
AIT-3.....	210.3	210.4	2.8 ₂	2.8 ₂
Experimental Equation: $y = 150.2 + 21.34x$				
A62M-1.....	165.2	165.4	0.8 ₀	0.7 ₀
A62M-2.....	183.4	183.2	1.7 ₄	1.7 ₄
A62M-3.....	201.6	201.7	2.7 ₂	2.7 ₂
Experimental Equation: $y = 150.2 + 18.94x$				
B62M-1.....	150.8	150.8	0	0.0 ₀
B62M-2.....	168.9	169.2	1.0 ₁	1.0 ₀
B62M-3.....	185.3	187.3	2.0 ₁	1.9 ₀
B62M-4.....	205.6	205.3	3.0 ₀	3.0 ₁
Experimental Equation: $y = 150.8 + 18.18x$				

lead fluid, it is easy to establish the limits within which Eq. 3 is valid. Precise analytical work is preferably done within those limits.

To illustrate how the comparative method was applied, detailed data are given in Table II for a measurement of the kind just discussed. While this table may give the misleading impression that such experiments are very time-consuming, it should be pointed out that the 20 output-current readings for each comparison were taken in 80 sec., and that the calculations can be done very rapidly—especially if the method is on an efficient routine basis. Furthermore, instruments designed for routine determinations make possible further savings of labor and time; in the General Electric X-ray photometer, for example, standard and unknown are compared 30 times a second.

ANALYSIS OF LEADED GASOLINE, BASE STOCK AVAILABLE

It is clear that the best standard for the determination of tetraethyllead fluid in a leaded gasoline should contain the base stock to which the fluid was added. Table III shows, however, that good results can be obtained when the standard is aluminum, provided the base stocks themselves are available, or the unknowns can be subdivided into series of which each has a common base stock.

Tetraethyllead fluid in four series of gasolines supplied by the Ethyl Corp. was determined by the comparative method on weighed samples, aluminum serving as standard. These tetraethyllead fluids could have contained dibromoethane or dichloroethane or both, in addition to the lead compound.

When the measurements were made, nothing was known about the samples

except that samples AOT-1 and B62M-1 were the only two base stocks involved. The 16 values of equivalent thickness obtained were transmitted to the Ethyl Corp., who interpreted the data as is shown in Table III (3).

The results in Table III subdivide themselves naturally into four groups, each group containing the same type of tetraethyllead fluid. Accordingly, the experimental data in column 2 establish four equations of the slope-intercept type, which are given in the table. Column 3 contains values of the equivalent thickness calculated from these equations, and the excellent agreement of calculated with observed values shows at once that high precision was attained in the work. Each value of x in column 5 was calculated from the corresponding observed equivalent thickness and the proper slope-intercept equation.

The values of x in column 4 were obtained by the Ethyl Corp. by a chemical method, for which the estimated precision is ± 0.02 ml. of tetraethyllead fluid per gallon. Comparison of columns 4 and 5 shows agreement within these limits for all samples except B62M-3; the reason for the considerably greater discrepancy here is unknown. In other words, this comparison establishes that the X-ray method is satisfactory as regards both accuracy and precision. It is particularly noteworthy that the difference in the absorbance of the base stocks, though small, clearly had to be considered in arriving at the tetraethyllead fluid contents of these leaded gasolines.

An unavoidable weakness in the analytical method under discussion is illustrated by sample B62M-3. It will be noticed that a discrepancy of about 1 per cent in the equivalent thickness y is multiplied about five-fold in the

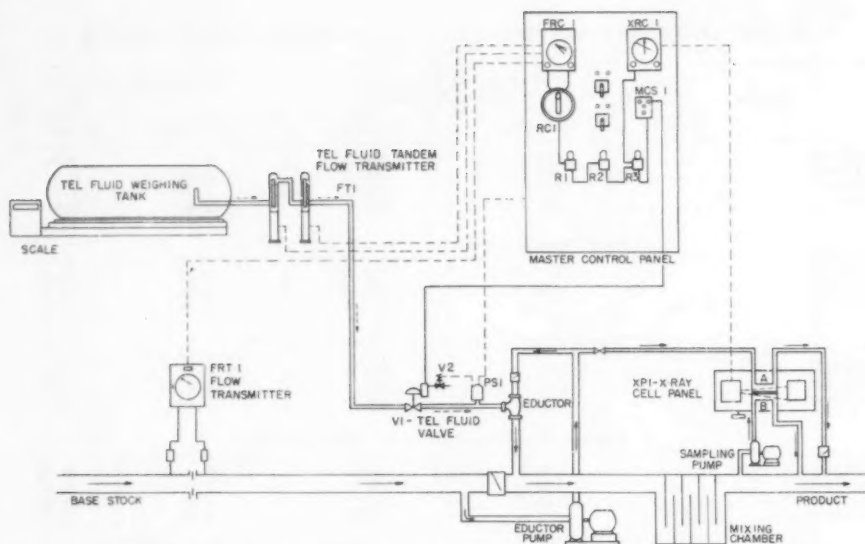


Fig. 2.—Schematic Diagram of Proposed System for Controlling the Automatic Blending of Tetraethyllead Fluid and Base Stock by Means of a G.E. X-Ray Photometer.

tetraethyllead fluid content. The reason is obvious: in the leaded gasoline, the tetraethyllead fluid is responsible for only about 20 per cent of the total absorbance.

PREPARATION OF LEADED GASOLINE

The foregoing X-ray method of comparing a leaded gasoline with the corresponding base stock, if it can be carried out continuously on the flowing liquids, is not far removed from an X-ray system for the automatic blending of tetraethyllead fluid and base stock. In principle, it is only necessary that the output current from the X-ray photometer be sufficient to actuate a servo system that can control the blending.

J. P. Smith, Industrial Engineering Divisions, General Electric Co., is responsible for the proposal shown schematically in Fig. 2, in which the G.E. X-ray photometer accomplishes the final control of the blending operation through a pneumatic servo system. The operation of Mr. Smith's proposed system, though it cannot be described in detail, is fairly clear from the equipment data in Table IV and the following two excerpts quoted from his report (4):

"The X-ray analysis equipment (XP1) causes an X-ray beam to be transmitted alternately through two flow cells. Cell A contains a continuously flowing sample of the raw gasoline stock. An aluminum disk of adjustable thickness increases the absorption of the X-ray beam passing through this cell to any desired amount. The second cell, B, contains a continuously flowing sample of product gasoline after blending with tetraethyllead fluid.

"An X-ray recording controller (XRC1) is located on the remote master control panel. This instrument continuously records deviation of the X-ray instrument (XP1) from balance. A pneumatic con-

troller in this instrument provides a 15-psi. loading pressure when the tetraethyllead blend is at the present value. Should the blend deviate by 0.03 ml. per gal. or more from this set value the loading pressure will be increased or decreased, and in conjunction with differential relay R3 will correct the position of valve V1 to provide the correct blend as required by the setting of the X-ray instrument."

ANALYSIS OF LEADED GASOLINE, BASE STOCK UNAVAILABLE

The determination of tetraethyllead fluid in a leaded gasoline by means of a single absorbance measurement becomes more difficult when the base stock from which the gasoline was prepared is unknown and unavailable for comparison. This complication is not due to the presence of organic halides in the tetraethyllead fluid, for this fluid may be regarded

TABLE IV.—DATA FOR PROPOSED SYSTEM SHOWN IN FIG. 2.

Base stock flow range.	Maximum = 8 X minimum
Blending ranges for flow control.....	(a) 0.2 to 1.0 ml. per gal. (b) 0.5 to 2.5 ml. per gal. (c) 1.2 to 6.0 ml. per gal.
Blending range for X-ray instrument.....	0.2 to 6.0 ml. per gal.
Sensitivity of X-ray instrument.....	±0.03 ml. per gal.
Calibrated range of X-ray recorder.....	±0.25 ml. per gal.

as a single component with an absorption coefficient modified according to the halide content.

It is not surprising that sulfur in an unknown base stock is principally responsible for the difficulty just mentioned. The very fact that sulfur in hydrocarbons has been successfully determined by X-ray absorption methods means that this element absorbs X-rays much more strongly than do the hydrocarbons (3, 5, 6). Consequently, the replacement of 1 or 2 per cent by weight of hydrocarbon with sulfur will raise the X-ray absorbance of an unleaded base stock to the point where it equals that of some leaded gasolines.

Methods I and II (Fig. 1) are specific and hence should not suffer directly from the presence of sulfur, although indirect difficulties, which should be minor, might ensue. In methods III and IV, the effect of sulfur can be allowed for if the approximate sulfur content is known. It has been discovered by the authors that tetraethyllead fluid and sulfur can be determined in the same gasoline by measuring the absorbance of the sample for two polychromatic beams suitably chosen. The method promises to be applicable

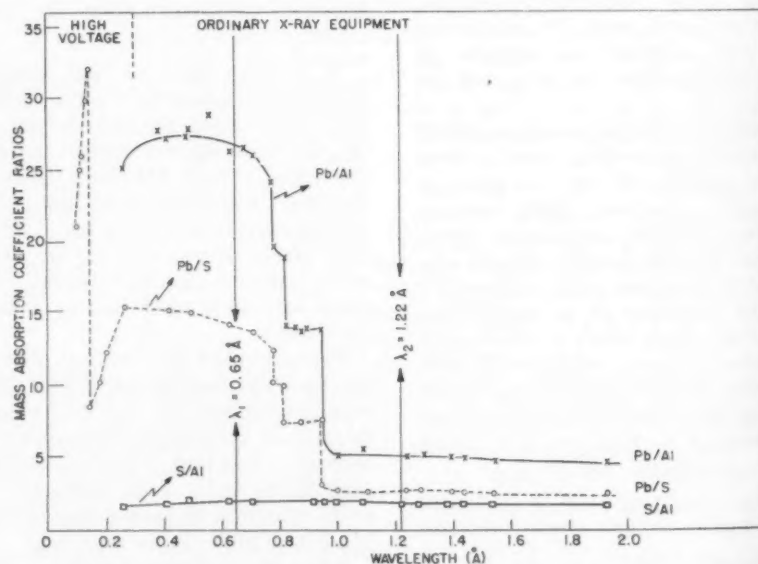


Fig. 3.—Mass-Absorption-Coefficient Ratios for Lead, Aluminum, and Sulfur.

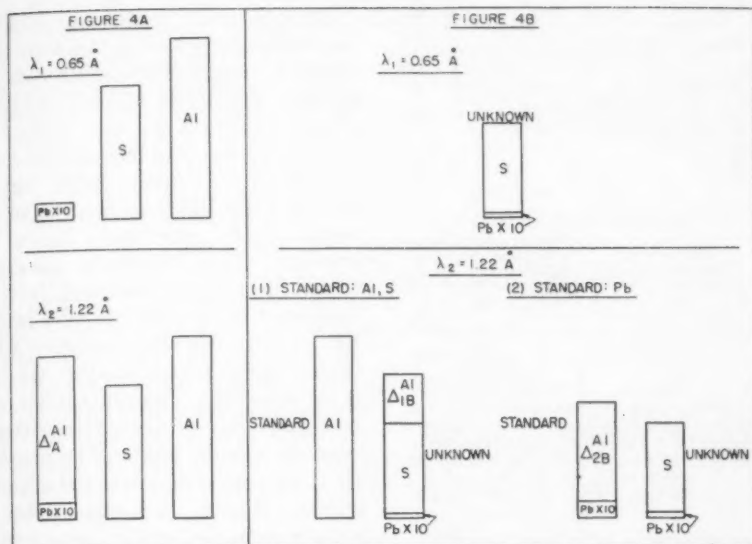


Fig. 4.—Simplified Illustration of New Analytical Method. (Note that Thicknesses of Lead Blocks Are Magnified Ten-Fold.)

in other cases where more than one element is to be determined, or where the presence of impurities prevents the satisfactory determination of an element based upon a single absorbance measurement by method III or IV.

The new method is best introduced by a simplified theoretical discussion restricted to monochromatic beams. For the purposes of this discussion, it is permissible to assume that the mass absorption coefficients of sulfur, of aluminum, and of lead vary as the cube of the wave length in regions of continuous absorption, and that only lead has absorption edges (the *L* edges) in the wave-length region of interest.

The relevant absorption-coefficient data are shown in Fig. 3. Inasmuch as concentrations of tetraethyllead and sulfur will be measured in terms of their equivalent thicknesses (mils) of aluminum, it is convenient to consider ratios of mass absorption coefficients.

The mass-absorption-coefficient ratio Pb/S goes through a sharp maximum at the *K* absorption edge of lead (near 0.14 Å), and the interference of sulfur in the tetraethyllead fluid determination is consequently at a minimum in this region. Unfortunately, high-voltage X-ray equipment is required for exploiting this advantage.

The method to be discussed depends upon the decreases in this Pb/S ratio that occur at the *L* absorption edges of lead (near 0.9 Å). The discussion will be based upon differences in absorbance that will be observed between measurements made at one wave length that is shorter (λ_1) and another that is longer (λ_2) than those of the *L* absorption edges. It is important for this method that the ratio S/Al is virtually constant over this wave-length region.

Figure 4A shows a block each of lead, sulfur, and aluminum with thicknesses chosen so that

$$[2.303a] \log [I_0/I_1] = \mu_1^{\text{Pb}} m_1^{\text{Pb}} = \mu_1^{\text{S}} m_1^{\text{S}} = \mu_1^{\text{Al}} m_1^{\text{Al}} \dots \dots \dots (4)$$

is identical for the three blocks. The reason for including the first term above is clear from Eq. 1; the other quantities may provisionally be regarded as depending on λ_1 (the subscript *m* has been omitted in writing the mass absorption coefficient).

Similarly, a block of each element (not shown in Fig. 4) can be selected so that at λ_2

$$[2.303a] \log [I_0/I_2] = \mu_2^{\text{Pb}} m_2^{\text{Pb}} = \mu_2^{\text{S}} m_2^{\text{S}} = \mu_2^{\text{Al}} m_2^{\text{Al}} \dots \dots \dots (5)$$

(Compare with Eq. 4. Note that a and m_1^{Al} are the same in both, which fixes the value of $\log [I_0/I_2]$.) Because μ_m^{S} and μ_m^{Al} have been assumed proportional to λ^3 , and because these elements have no absorption edges in the wave-length region considered, it follows that

$$\mu_2^{\text{S}}/\mu_1^{\text{S}} = \mu_2^{\text{Al}}/\mu_1^{\text{Al}} \text{ (see Fig. 3).} \dots \dots \dots (6)$$

and consequently that

$$m_2^{\text{S}} = m_1^{\text{S}} \dots \dots \dots (7)$$

Owing to the presence of the *L* absorption edges of lead, however,

$$m_2^{\text{Pb}} > m_1^{\text{Pb}} \text{ or } m_2^{\text{Pb}} = m_1^{\text{Pb}} + \Delta m^{\text{Pb}} \dots (8)$$

Instead of increasing the thickness of the lead block to maintain equivalent absorbance, we may add aluminum so that (see Fig. 4A)

$$[2.303a] \log [I_0/I_2] = \mu_2^{\text{Pb}} m_1^{\text{Pb}} + \mu_2^{\text{Al}} \Delta A^{\text{Al}} = \mu_2^{\text{S}} m_1^{\text{S}} = \mu_2^{\text{Al}} m_1^{\text{Al}} \dots \dots \dots (5a)$$

A lead and a sulfur block showing equivalent absorbance at λ_1 will thus

differ in absorbance at λ_2 by ΔA^{Al} . (In equations such as 5a, consider ΔA^{Al} to be a mass. In actual practice it is a thickness.) Furthermore, this difference, ΔA^{Al} will be proportional to the thickness of the lead block and—at constant area—to m_1^{Pb} . This is the basis of the analytical method.

Consider now the analysis of an "unknown" that can contain only lead and sulfur (see Fig. 4B). The size of sample is chosen so that its absorbance at λ_1 is equivalent to that of any block at the top of Fig. 4A. By adding ΔA^{Al} mils of aluminum, balanced absorbance is attained at λ_2 . The value of ΔA^{Al} measures the amount of lead (and hence of sulfur) in the sample. Note, however, that the measurement at λ_2 is influenced by the standard chosen. If either aluminum or sulfur is selected, balance at λ_2 is achieved by placing additional aluminum on the side of the unknown. If lead is the standard, the additional aluminum will have to be added to the standard. In the former case, this aluminum is proportional to the lead in the unknown; in the latter, to the difference between the lead contents of standard and unknown; hence

$$\Delta A^{\text{Al}} = \Delta A_1^{\text{Al}} + \Delta A_2^{\text{Al}} \dots \dots \dots (9)$$

Of course, the actual analytical problem is considerably more complex than that represented in Fig. 4B. These complexities arise from the facts that a leaded gasoline contains more than just sulfur and lead, and that the analytical method employs two polychromatic beams, each of which contains a large number of wave lengths.

The determination of tetraethyllead fluid in a leaded gasoline containing sulfur resembles the analytical problem of Fig. 4B in the presence of hydrocarbon in high proportion. In the absence of sulfur, a leaded gasoline might be 99.9 per cent hydrocarbon. Even with sulfur present, it will usually be about 99 per cent hydrocarbon. Furthermore, the hydrocarbon in a leaded gasoline can well account for 80 per cent of the X-ray absorbance. It seems reasonable, therefore, to use a hydrocarbon as standard for the determination of tetraethyllead fluid in gasolines containing sulfur.

Accordingly, isooctane of known tetraethyllead content was balanced in a polychromatic beam corresponding to λ_1 against an equal weight of isooctane to which aluminum was added. When a similar measurement had been made in a polychromatic beam corresponding to λ_2 , the value of milliliters of tetraethyllead fluid per gallon divided by ΔA^{Al} was calculated. (Values of ΔA^{Al} were obtained at two tetraethyllead fluid concentrations.) Samples con-

TABLE V.—TETRAETHYLLEAD FLUID DETERMINATIONS WITH ISOCTANE AS STANDARD.

(a) STANDARDIZATION					
Sample	Tetraethyllead Fluid, ml. per gal.	Sulfur, per cent	Mils of Aluminum (λ_1)	Mils of Aluminum (λ_2)	ΔA^I , mils
1.....	1.979	Nil	7.56	1.82	5.74
2.....	4.089	Nil	15.01	3.48	11.53

(b) DETERMINATIONS					
Sample	Added Sulfur, per cent	Added Tetraethyllead Fluid, ml. per gal.	ΔA^I , mils	Preliminary Tetraethyllead Fluid, ml. per gal.	Sulfur and Tetraethyllead Fluid as Milliliters Tetraethyllead Fluid per gal.
3DS.....	0.98	5.09	14.65	5.27	7.06
2C.....	0.47	4.11	11.67	4.14	4.93
3B.....	0.91	2.57	7.72	2.69	4.17
2AS.....	0.55	1.99	5.89	2.03	2.90
3A.....	0.91	0.76	2.61	0.89	2.29

NOTE.—Samples and standards weighed 8.964 ± 0.011 g. Depth of liquid in cells, about 3 cm. Determinations in last column calculated from corresponding mils of aluminum (λ_1) values, sulfur also being expressed as milliliters of tetraethyllead fluid per gal. Molybdenum target. Polychromatic beam at 42.2 kv. peak has an effective wave length near 0.65 Å and hence corresponds to λ_1 . Similar beam at 12.1 kv. peak has an effective wave length near 1.22 Å and hence corresponds to λ_2 . From now on, λ_1 and λ_2 will be used to represent these polychromatic beams.

(c) ILLUSTRATIVE CALCULATIONS

Standardization: $1.979/5.74 = 0.3448$; $4.089/11.53 = 0.3546$.
 For interpolation, take (ml. tetraethyllead fluid per gal.) / $\Delta A^I = 0.3350 + 0.0017 \Delta A^I = \text{factor}$.
 Determination: Sample 3DS, factor = $0.3350 + 0.0017 (14.65) = 0.3599$; $0.3599 (14.65) = 5.27$ ml. tetraethyllead fluid per gal.

taining tetraethyllead fluid and added sulfur were then run by the same procedure as unknowns against isooctane, the weight of each being that used during the standardization. The results are given in Table V.

In Table V, the results of determinations in column 6 are considerably greater than those in column 5, which in turn are all somewhat larger than those in column 3. Determining tetraethyllead fluid by the proposed method with isooctane as standard is thus considerably better than having the sulfur appear as tetraethyllead fluid on the basis of a single absorbance measurement (column 6), but it is not yet good enough.

Inasmuch as the results of determinations in column 5 are all higher than those in column 3, a systematic error is probably present. In the simplified theoretical introduction, it was shown that ΔA^I should measure only the lead present, and the results in column 5 were calculated on this basis. Data are presented in Table VI to show that part of ΔA^I must be attributed to sulfur under the experimental conditions, so that we shall have to write

$$\Delta A^I = \Delta_{\text{TEL}} A^I + \Delta_S A^I \dots (10)$$

TABLE VI.—ISOOCTANE SOLUTIONS OF KNOWN SULFUR CONTENT AGAINST ISOCTANE AS STANDARD

Sample	Sulfur, per cent by weight	Mils of Aluminum, λ_1	Mils of Aluminum, λ_2	$\Delta S A^I$, mils
No. 3...	0.47	3.35	3.08	0.27
No. 4...	1.06	6.65	6.16	0.49

For interpolation, take $\Delta S A^I$ (per cent S) = $0.664 - 0.190 (\text{per cent S}) = \text{factor}$.

The experiments parallel the standardization experiments in Table V except that known solutions of thiophene in

TABLE VII.—SULFUR AND TETRAETHYLLEAD CONTENTS OF GASOLINES.

Sample	Mils of Aluminum, λ_1	Preliminary Sulfur, per cent	Final Sulfur, per cent	Added Sulfur, per cent	Final Tetraethyllead Fluid, ml. per gal.	Added Tetraethyllead Fluid, ml. per gal.
3DS.....	24.70	0.90	1.00	0.98	5.10	5.09
2C.....	17.85	0.36	0.41	0.47	4.06	4.11
3B.....	15.28	0.78	0.87	0.91	2.54	2.57
2AS.....	10.89	0.44	0.49	0.55	1.94	1.99
3A.....	8.71	0.79	0.89	0.91	0.75	0.76

isooctane were the samples. In order to apply Eq. 10 in correcting column 5, Table V, it is necessary to know the sulfur contents of the samples. Preliminary values of these sulfur contents were calculated from the mils of aluminum (λ_1) values of the standards (samples 1, 2, 3, 4) and of the unknowns (see Tables V, VI, and VII) according to the additive relation

$$\text{mils of aluminum } (\lambda_1) = \text{mils of aluminum } (\lambda_1)_S + \text{mils of aluminum } (\lambda_1)_{\text{TEL}} \dots (11)$$

The procedure is to calculate mils of aluminum (λ_1)_{TEL} from the preliminary tetraethyllead values in Table V (b) by using an interpolation equation analogous to that below Table V but based on mils of aluminum (λ_1) for samples 1 and 2. Corresponding values of mils of aluminum (λ_1)_S are then obtained (Eq. 11), from which preliminary sulfur contents are computed by using an interpolation equation based on the mils of aluminum (λ_1) data of Table VI. These preliminary sulfur contents are given in column 3, Table VII. The preliminary sulfur contents were next used to calculate values of $\Delta S A^I$ by applying the equation at the bottom of Table VI. These values then led to $\Delta_{\text{TEL}} A^I$ values by Eq. 10, and from these the final tetraethyllead contents given in Table VII were calculated by using the factor defined in Table V (c).

The final sulfur contents in Table VII were obtained by using the final tetraethyllead contents in calculations patterned after those which yielded the preliminary sulfur values.

For tetraethyllead fluid and for sulfur, comparison of "final" with "added" data in Table VII shows agreement that seems highly satisfactory for a first attempt. The method is susceptible of considerable improvement, however, because it is cumbersome, and because the primary condition for satisfactory comparative measurements (Eq. 3) is not satisfied. These objections could both be made a great deal less stringent were the method put on a routine basis by setting up complete standardization curves. Finally, it is certain that the situation can be further improved by using tetraethyllead fluid in gasoline as a standard, but time was lacking to complete this investigation.

The new method has been examined in considerable detail to show that it can be placed on a firm quantitative footing. Obviously, it has considerable merit also as a qualitative or semi-quantitative test for impurities that interfere with determinations based on a single absorbance measurement. Used in this way, the method could be made extremely rapid, and it would often be possible to estimate tetraethyllead fluid with fair precision even though only the level of sulfur content is known. (In this connection, see paper by Vollmar, *et al.* (6), Fig. 4).

Acknowledgments:

The authors wish to thank George Calingaert and Miss Frances W. Lamb, both of the Ethyl Corp., for their cooperation on this project. The authors are grateful to Mrs. Miriam B. Lennig of this laboratory for helping with the measurements and calculations.

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DISCUSSION

MR. W. J. TROELLER, JR.¹—The paper by Liebhafsky and Winslow has characterized four methods of X-ray analysis which can be used for the determination of tetraethyllead in gasoline. It would seem that a fifth method should be included in this list; the one outlined by the authors and based on absorption measurements of polychromatic radiation at two effective wave lengths. This procedure appears to us to be a compromise between the polychromatic and monochromatic, the specific and nonspecific methods. It

retains the high intensity which is the chief advantage of polychromatic radiation, while, at the same time, comparing absorption in different regions of the spectrum.

The single reading absorption method described by the authors was covered in great detail by the second paper in the Symposium and, therefore, requires no comment here. But the second method, involving readings at two effective wave lengths, appears to be one immediate answer to the sulfur interference problem. As pointed out in the paper, the method of successive approximations appears rather cumbersome, however, working from complete

calibration curves should expedite the procedure considerably.

The X-ray plant analyzer for the automatic control of tetraethyllead blending operations proposed by Mr. J. P. Smith appears to be a very sound and practical device. Similar devices, utilizing infrared, have been used successfully for some time, not for the control of tetraethyllead blending, of course, but for the control of various plant processes. Since, in any blending operation, the base stock is always available, it seems to us that this same instrument could be used to control a host of blending operations as, for example, the blending of additives in oil.

¹ Esso Laboratories, Standard Oil Development Co., Linden, N. J.

Discussion of Paper on Some Applications of Modern Microscopy to the Study of Chemical Phenomena and in the Dyeing and Printing of Textiles¹

MR. P. N. CHEREMISINOFF² (*by letter*).—Rapid identification and quantitative data of textile fibers is possible by use of the chemical microscope. Data on fiber diameters, which are obtainable through microscopic measurement, are especially useful in the grading of fibers such as wool. By determining the average fiber diameter of a particular sample it is possible to class the wool fiber as full blood or fine (20 μ); $\frac{3}{4}$ blood or $\frac{1}{2}$ high (21 μ); $\frac{1}{2}$ blood (23 to 25 μ wool to be expected from $\frac{1}{2}$ blood Marino sheep); $\frac{3}{8}$ blood (29 μ); etc.

Microchemical reactions of fibers can also be studied by microscopic observation. For example, cotton fibers when treated with iodine and sulfuric acid will swell and become blue. In raw cotton, parts of the lumen and cuticle are colored yellow if treated with these reagents. Another interesting reaction of unprocessed cotton fiber is the "blowing up" upon treatment with

ammoniacal copper solution or trimethylbenzylammonium hydroxide. In any microscopic study of textile fibers the aid of stains should not be overlooked in bringing out physical features which may not otherwise be accented, and even concealed. As further example, if reuthenium red is employed with the above reagents, the lumen wall and protoplasmic parts in the cotton fiber can be stained a reddish purple, bringing these parts out against the cellulose wall which will not stain under these conditions.

Mr. Royer, in his paper, outlines the more important microscopic methods available with which to carry out possible investigations. Among those mentioned are two very useful methods in fiber study, use of polarized light and dark field illumination. As illustration of the effects obtainable with polarized light, cotton fibers will exhibit double refraction and various color effects can be observed. Second order yellow and blue characterize unprocessed cotton if a first order selenite plate is used in conjunction with the microscope, and reversal of colors may be effected by rotation of the fiber 90 deg. By use of

this technique, structural details which would otherwise be lost can be brought out.

In conclusion it may be stated that the features most readily studied in textile fibers by the chemical microscope are physical differences between various fibers, cross-sections and shapes, dimensions, and response to chemical reaction and treatment.

MR. G. L. ROYER³ (*author's closure*).—The paper does not cover all applications of modern microscopy (the title mentions "some"). The items which Mr. Cheremisinoff enumerated are also of interest and importance and have been described in the literature. I am sure that many other examples could have been included in the paper, but the paper was meant to cover some of the work which we have been carrying out in our laboratory. It was prepared to cover the illustrated talk which was given at the meeting of Committee D-13 and was not intended as being all inclusive.

¹ G. L. Royer, "Some Applications of Modern Microscopy to the Study of Chemical Phenomena and in the Dyeing and Printing of Textiles," *ASTM BULLETIN*, No. 165, April, 1950, p. 46 (TP72).

² Research Chemist, M. W. Parsons Co., New York, N. Y.

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Dimensional Stability of Woolen and Worsted Fabrics¹

By Werner von Bergen² and Claude S. Clutz³

IN THE November, 1949, issue of *Wool Science Review*, published by the International Wool Secretariat (Scientific and Technical Department) an article appeared on "Cloth Shrinkage in Garment Production."⁴ The introductory statement of this article is as follows:

"Cloth shrinkage is undoubtedly the problem which causes most controversy between the cloth manufacturer and the 'maker-up.' Much of this controversy is due to the lack of technical knowledge of each section of the industry of the processes used by the other. Many of the factors contributing to cloth shrinkage are, however, well established."

This can, without hesitation, also be applied to the conditions in the United

States. The amazing thing is that, with all the efforts extended in the last twenty years, this problem is still far from a satisfactory solution.

Two main types of cloth shrinkage are recognized—the one known as *relaxation shrinkage* and the other as *felting shrinkage*. The first is regarded as the main factor in the tailoring of a garment, while felting is important in the washing of woolen fabrics. A third type of movement in wool fabrics—that caused by *change in relative humidity*—has been found to play an important part in the appearance of lightweight men's suiting, such as the tropical worsteds. This was especially observed in suits worn in sections of the country where high humidities prevail,

movement in the warp and filling directions on going from 20 to 90 per cent relative humidity.⁵ Going from low to high humidity the cloth stretched; going in the opposite direction, the cloth shrunk. Depending on the type of fabric, this cloth movement varied from 2 to 4 per cent.

The solution was thought to be in delivering the goods to the tailor with a moisture content equal to the equilibrium obtained at 60 per cent R.H. It was reasoned that the cloth movement in either direction would only be half of the total amount. It is interesting to note that a tailoring house recently advertised that it would tailor suits specifically for the various sections of the country in order to give the best ap-

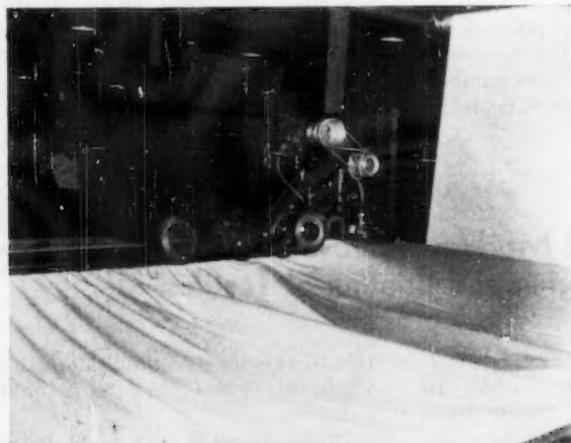


Fig. 1.—Overfeeding Mechanism on Tenter Drier (Krantz).

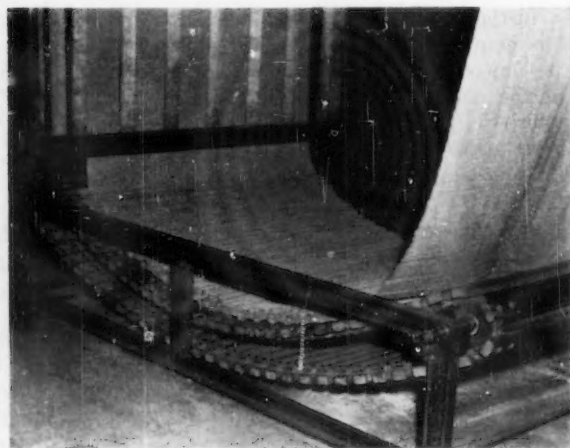


Fig. 3.—London Shrinkage—Relaxation Scray.

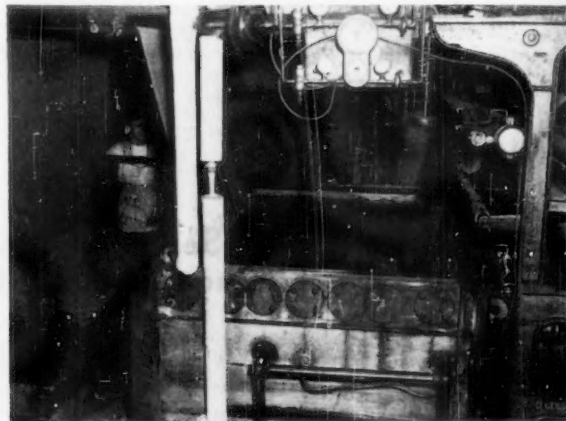


Fig. 2.—London Shrinkage—Wetting-out Bath.



Fig. 4.—London Shrinkage—Drier Exit.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

¹ This report was given at the Papers Session of the Meeting of Committee D-13 on Textile Materials held in New York, N. Y., March 16, 1950; and also at the Fiber Society Meeting, April 27, 1950, in Fontana Village, N. C.

² Chairman, Subcommittee A-3 of A.S.T.M. Committee D-13; Director of Research, Forstmann Woolen Co., Passaic, N. J.

for instance, Florida.

As early as 1939, studies were made in the Forstmann Woolen Co. laboratories which revealed considerable cloth

³ Research Physicist, Forstmann Woolen Co., Passaic, N. J.

⁴ "Cloth Shrinkage in Garment Production," *Wool Science Review*, No. 4, pp. 25-34 (1949).

pearing garments for the prevailing humidity conditions.

To find a real solution to this problem, it is necessary not only to study the mill processes, but also the steps a piece of

⁵ Hereafter relative humidity will be abbreviated R.H.

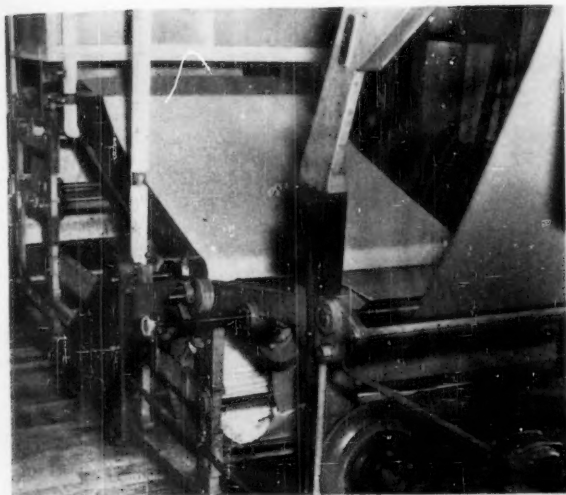


Fig. 5.—Open Steaming and Cooling.

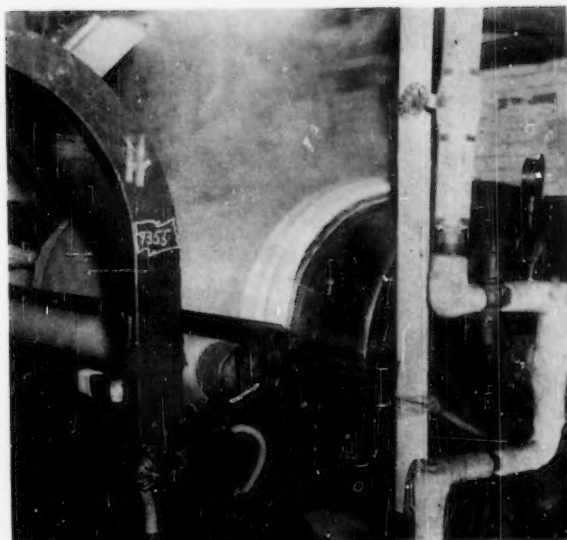


Fig. 6.—Leader Decating.

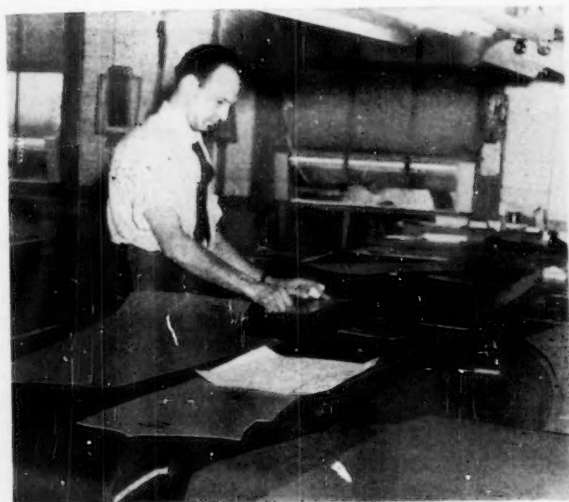


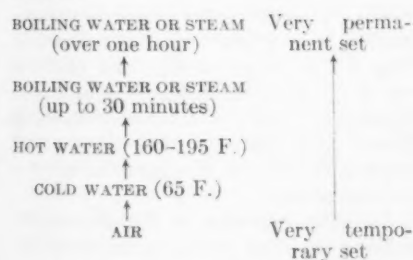
Fig. 7.—Lay-out of Pattern and Cutting of Cloth.



Fig. 8.—Shape Pressing of Left and Right Fronts.

cloth goes through during its tailoring into a garment.

In the article mentioned above, the conditions governing the relaxation of stretch are outlined in a diagram⁶ as follows:



It is stated that any setting which has occurred under one of the conditions listed in the figure can be relaxed by submitting the fabric to any of the more severe conditions given higher on the list. If a wool fiber, yarn, or cloth is stretched in dry air, only a very tempo-

rary set can be produced. As soon as such a fabric is brought in contact with water, the stretch will be relaxed.

It is clear that water temperature and time are the important factors in producing set, the permanency of a set increasing as the time and temperature increase. The fundamentals underlying this conception were first published by Speakman.⁷

The findings of this paper show that the "permanent set" as produced by the final decating machine in the fabric finishing operations, as well as that produced by the Hoffmann press used in the tailoring of garments, can be removed simply by exposing the fabric or garment to high humidity (90 per cent or more) at normal temperature.

In the following sections, the authors will cover the main processes a piece of cloth is put through in order to reduce relaxation shrinkage to a minimum and also the main steps this same cloth goes through in a tailoring shop.

Data are given showing how wool

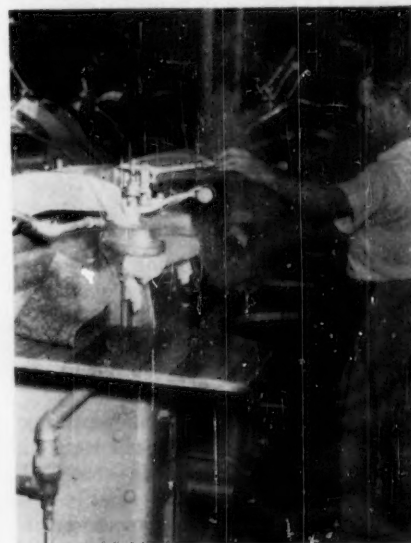


Fig. 9.—Collar Pressing.

fabrics change in their warp and filling dimensions. These dimensional changes are shown to be attributable to three

⁶ In the original drawing the direction of the arrows was opposite to that shown here.

⁷ J. B. Speakman, Lecture delivered at a meeting of the Bradford Textile Society, Jan. 23, 1933.



Fig. 10.—Armhole Pressing.



Fig. 11.—Final Hand Pressing of Entire Coat.



Fig. 12.—Final Examining of Coat.

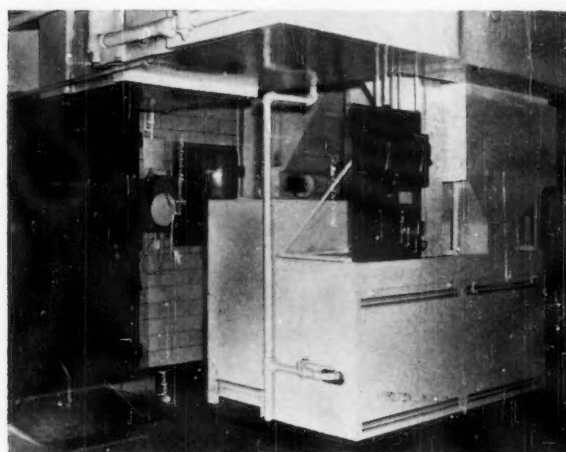


Fig. 13.—Henry Booth Special Conditioning Room.

causes: (1) change in moisture content of the fabric, (2) relaxation shrinkage, and (3) strain due to external stresses. The study includes the action of the Hoffmann press and its use to establish relaxation shrinkage of woolen and worsted fabrics. Felting shrinkage is not discussed in this paper.

MILL OPERATIONS

The operations covering the pre-shrinking of cloth in a mill or sponging house may be segregated into two groups: namely, the shrinkage by treatment with steam alone, and shrinkage by treatment with cold water.

The modern drying and tentering frames used in the woolen and worsted industry are equipped with electrical feeding mechanisms which allow over-feeding of the material as it enters the dryer. Such a mechanism is shown in Fig. 1. The cloth in this picture is fed in with an overfeed amounting to 15 per cent which gives the fabric a chance to fully relax in the warp direction during

the drying operation, whereas the shrinkage of the filling is controlled by tentering.

Following the tentering and drying operation, the pieces are subjected to open steaming, cooling, and leader deating which will be described later.

In production cold-water shrinkage is done on continuous London shrinking machines. These consist of three sections: wetting out (Fig. 2), relaxation (Fig. 3), and drying. Figure 4 shows the piece leaving the drying section. As seen from these pictures, the cloth is allowed to shrink freely in the warp as well as in the filling direction.

No matter what method is used—over feeding on the dryer or the cold-water shrinkage—it is necessary to subject the goods coming from the dryer to steam treatments in order to remove folds and wrinkles created in the shrinkage process. One type of machine is shown in Fig. 5. It consists of a steaming unit, a heating or shrinking table, and a cooling apparatus. The cloth

enters at the steaming unit which consists of two steam boxes. From there it slides over the top of the inclined heating table, falls into a scray where a few yards of the fabric are accumulated, and then passes over a cooling trough connected to a powerful suction blower.

For the final setting and smoothing, the fabric is subjected to a steam treatment in a deating machine as shown in Fig. 6. In this machine the cloth is wound with a cotton leader onto a perforated cylinder through which steam is blown. The removal of the steam and cooling of the piece is accomplished by a suction pump.

In order to maintain the piece in its relaxed position as delivered from the drying units, it is essential that both the steaming operations are accomplished with the lowest possible fabric tension.

STEPS IN TAILORING

There are approximately 50 operations involved in the tailoring of a man's coat. So far as cloth movement is concerned, of most importance is the condition of the cloth as unrolled from the bolt and as subjected to the various

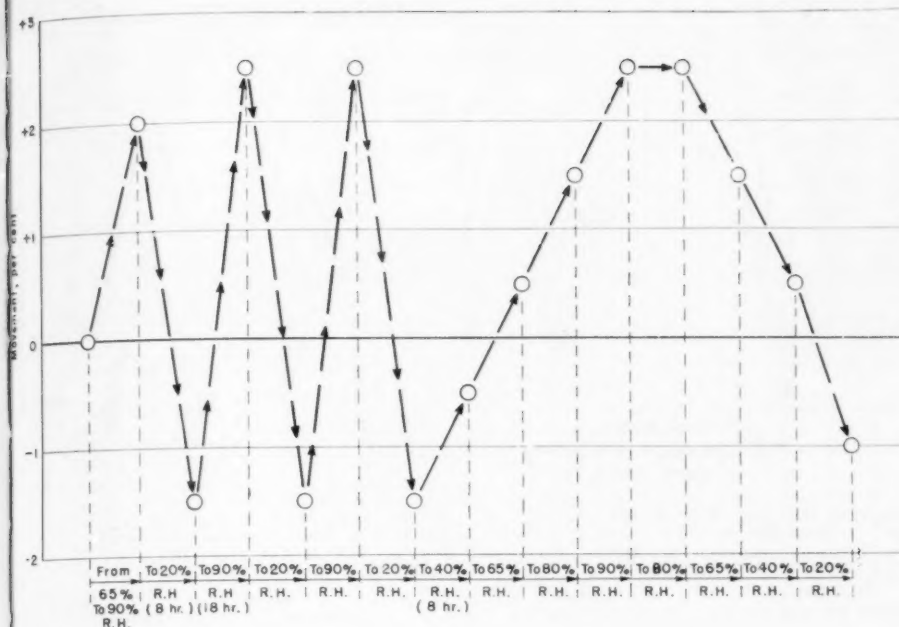


Fig. 14.—Movement of 13-oz. Gabardine with Relative Humidity.

Measured in warp direction with material lying on table and minimum conditioning time of 8 hr. Slopes of lines in this figure have no significance as plotted since only the movement is drawn to scale.

steaming operations either on the Hoffmann press or with the hand iron.

Seventeen individual pressings are applied to various parts of the coat. These include dart pressing, seam pressing, pocket pressing, collar pressing, etc. Each part is repeatedly pressed between five and seven times, resulting in an average total pressing time of four minutes. In these operations the cloth may be subjected to temperatures from 160 to 300 F.

In the tailoring house in which these observations were made, garment manufacturing is composed of individual cutting with shears and sectionalized custom tailoring. A suit is made directly to the customer's specifications rather than a standard pattern size.

Figure 7 shows a cutter at work. The necessary amount of cloth has been unrolled from the bolt and the cutter has laid out and traced the left side of the pattern on the double folded material. In this way, both the left and right sides will be cut simultaneously. Here a shrinkage or an expansion of the cloth will occur, depending on the time the cloth lies on the table and the relative humidity conditions, that is, the change in moisture content of the fabric.

Figure 8 shows the pressing of the entire coat front in a contour press. As the picture indicates, both plates of the press are shaped to the desired form of the body. When the press is closed, steam is applied through the top part of the press for several seconds. The press is kept in the closed position for approximately thirty seconds, depend-

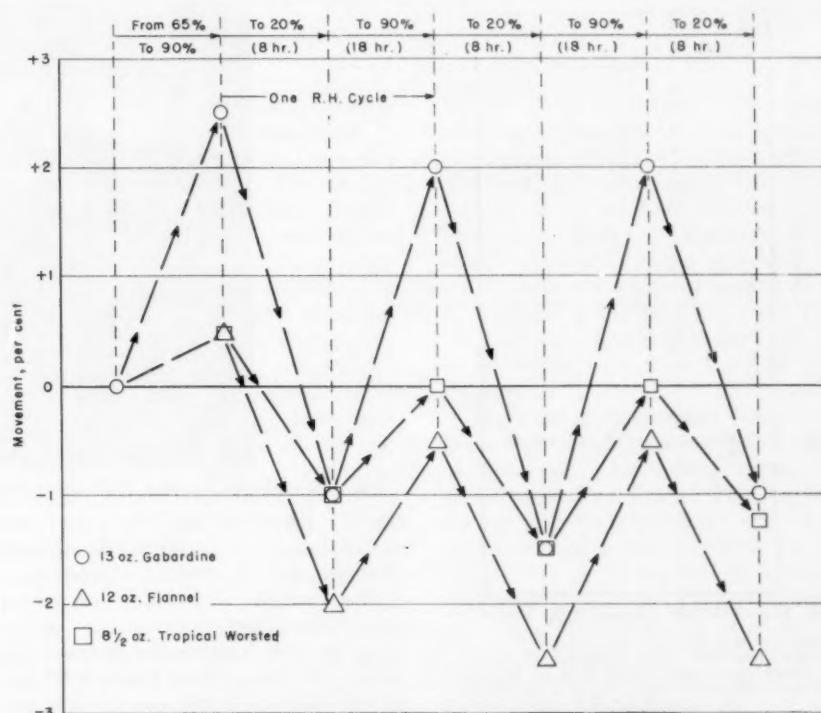


Fig. 15.—Movement of Fabrics with Relative Humidity.

Measured in warp direction with material lying flat and at 70 F.

ing on the work load of the presser.

Figure 9 illustrates the final pressing of the entire collar. The beds of the press are specially shaped to fit the collar section. Figure 10 shows the last machine-pressing operation in which the bed-type press is shaped to fit the armhole. Following this pressing, the coat goes through examining, button sewing, and final hand pressing with a damp cloth and hand iron as shown in

Fig. 11. The final examiner checks all measurements as seen in Fig. 12.

Depending on the part of the garment—waist or seat—the successive pressing operations shrink the cloth from 0 to 5 per cent according to the state in which the piece was prior to tailoring. Actually, an expansion of the fabric is expected in the waist; whereas in the over-all length and the seat, shrinkages of 2 per cent are expected.

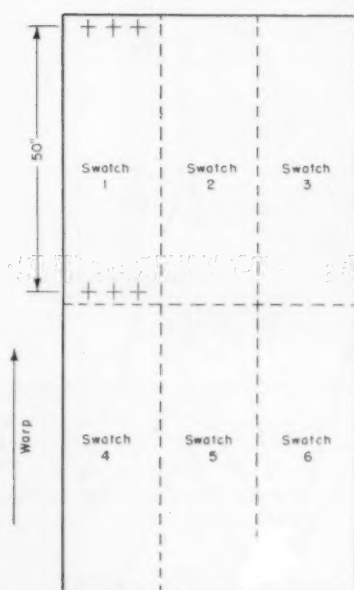
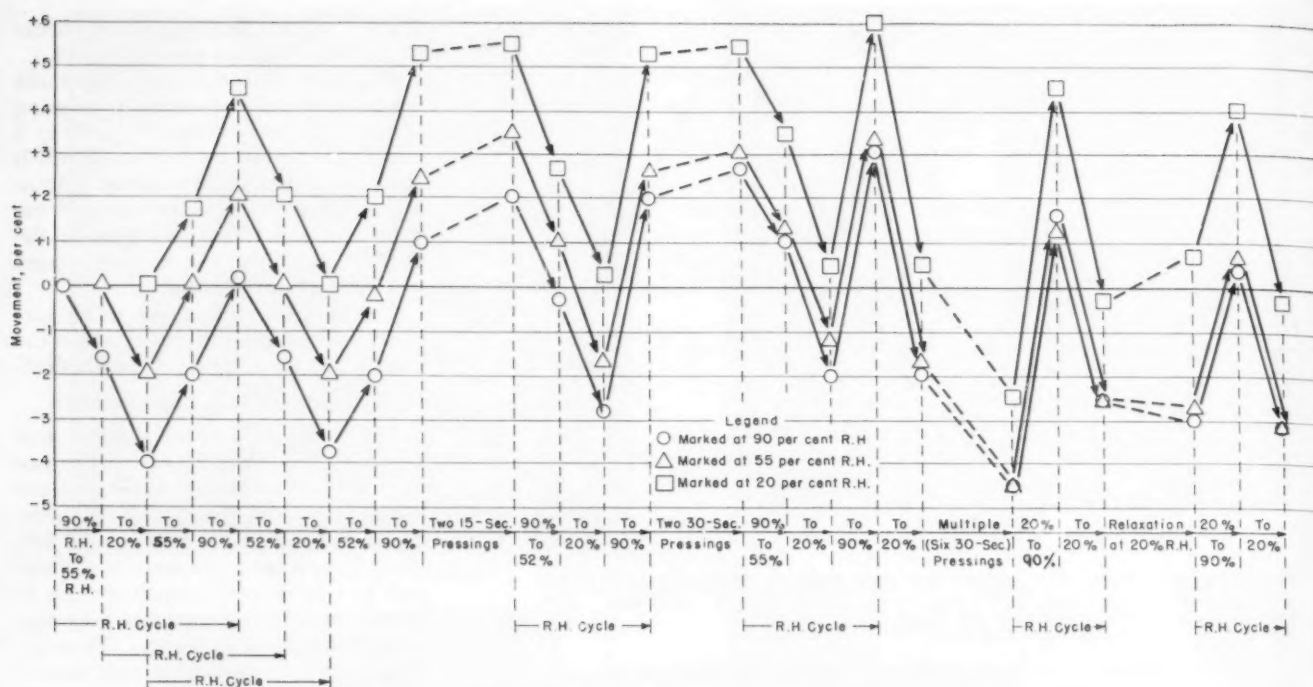
The final pressing of the entire garment with a wet cloth will establish the level of the final setting of the garment.

CHANGE IN MOISTURE CONTENT

The hygroscopicity of wool is well known. This property of wool is one of its greatest assets; however, it is not fully appreciated that it causes appreciable dimensional changes in wool fabrics. The change in the amount of moisture in a fabric with normal changes in weather conditions produces very significant effects in garments. These effects reflect themselves in two ways—change in the size of the tailored garments, and changes in general appearance.

The literature contains abundant information on the equilibrium moisture content of wool fibers. Considerable data are available on the cross-sectional swelling of wool fibers at various moisture contents; however, the available information on longitudinal swelling is very limited. Brauckhoff⁸ gave axial

⁸ H. Brauckhoff, "Changes in Condition of Normal, Dry, and Stretched Hair in Relation to the Relative Humidity," *Biochemische Zeitschrift*, Vol. 317, pp. 159-167 (1944).



Swatches 1, 2, and 3 tumbled; swatches 4, 5, and 6, suspended; swatches 1 and 6 marked at 20 per cent R.H., swatches 3 and 4 marked at 55 per cent R.H., and swatches 2 and 5 marked at 90 per cent R.H.

swelling values of 1.7 to 2 per cent between the dry and saturated conditions for wool fibers and found this swelling to be independent of fineness and color. In the article by Preston and Nimkar,⁹ data are listed from the literature on diametric, axial, and volumetric swelling of several textile fibers. Axial swelling for wool is not included in this tabulation. From the diametric swell-

⁹ J. M. Preston and M. V. Nimkar, "Measuring the Swelling of Fibres in Water," *Journal of the Textile Inst.*, Vol. 40, No. 7, pp. P674-688 (1949).

The Foxboro Co., which has had a great deal of experience in the use of hairs in their hygrometer instruments, states that human hair between 20 and 88 per cent R.H. will change 0.94 per cent in length. Animal membrane moves 1.9 per cent in length between 20 and 80 per cent R.H.¹⁰

The study of the correlation between the swelling of wool fibers and the motion of wool fabrics, with changes in humidity, has been neglected. The only reference found in the literature is the article in *Wool Science Review*,⁴ which indicates a per cent area shrinkage of an undescribed fabric when

¹⁰ Communication from Foxboro Co., October 24, 1949.

cycled between wet and dry.

R.H. Motion of Fabrics:

The change in the moisture content of fabrics directly affects the change in the dimensions of the fabric. The moisture content of a fabric corresponds to equilibrium at a certain relative humidity. By studying the correlation of the motion with changes of relative humidity, a measure of the fabric's sensitivity to changes in atmospheric conditions is obtained. The dimensional change of the fabric with changes in relative humidity is termed "R.H. motion."

Test Procedure.—In measuring the dimensional changes in fabrics with changes in relative humidity, the fabric is conditioned to a standard atmosphere of 65 per cent R.H. at 70 F. It is then marked in three locations and brought

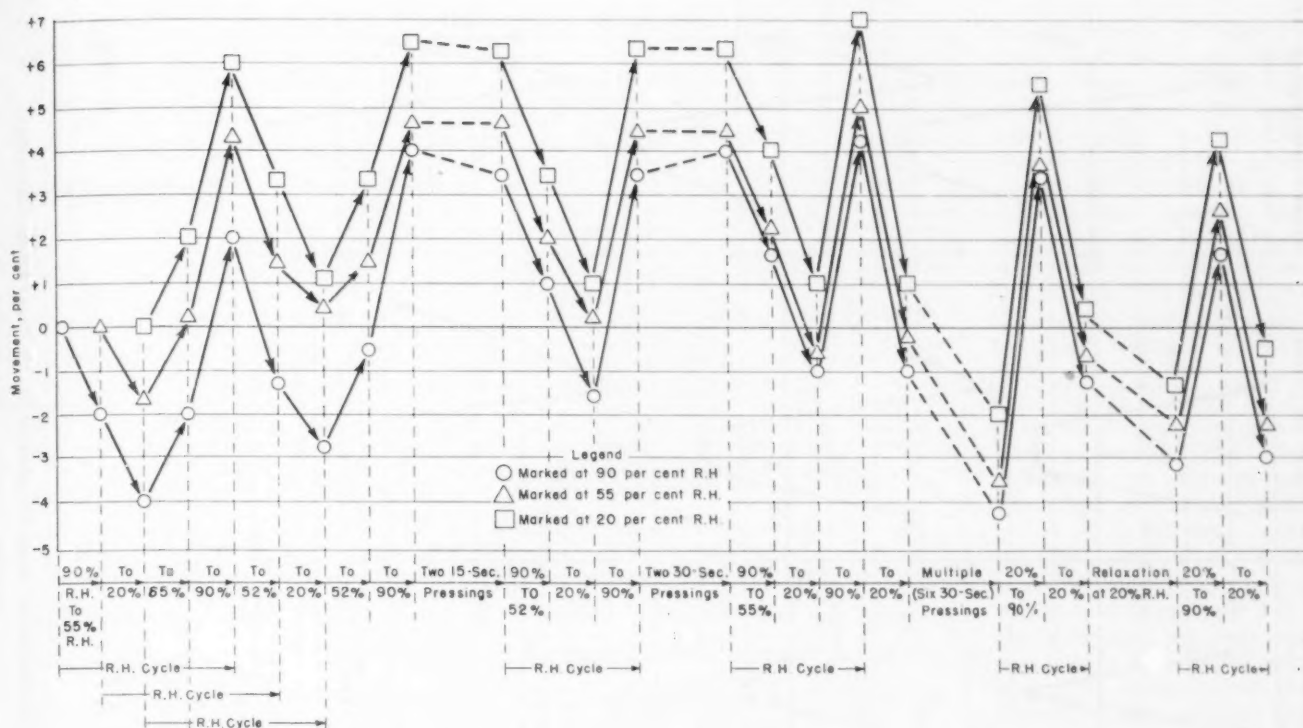


Fig. 19.—Movement of Men's Wear Gabardine with Changes in Relative Humidity

At 70 F. with material suspended; measured in warp direction.

into equilibrium, at 90 per cent R.H. This is done in a special conditioning room, originally conceived by Henry Booth,¹¹ which measures 12 by 13 by 8½ ft. The conditioning equipment is external and is adequate to provide a temperature range of 40 to 100 F., and relative humidities ranging from 20 to 90 per cent. Stabilizing to ± 1 F. and ± 2 per cent R.H. at any combination of intermediate values within ½ hr. is possible (Fig. 13).

After the fabrics are conditioned in this room to 90 per cent R.H., the dimensional change is measured using steel trammels on a beam which has been directly calibrated in per cent change. The fabric is then brought into equilibrium with 20 per cent R.H., which for practical purposes requires not less than 8 hr. It is measured and again brought to equilibrium with 90 per cent R.H. (requires 18 hr.) and re-measured. This completes one cycle¹²; three cycles are run on each sample.

Data.—The effect of R.H. cycling is indicated in Fig. 14 which shows the change in the warp direction of a gabardine fabric between 20 and 90 per cent

R.H. Also included are measurements at intermediate relative humidities.

In Fig. 15 similar diagrams are shown for three types of fabric. The flannel and the tropical worsted move similar amounts whereas the gabardine moves to a much greater extent. In general, gabardines move more than other fabrics. This can be attributed primarily to the weave structure and the predominance of warp yarn in weight.

Figure 16 shows a combination of R.H. motion and shrinkage tests on a gabardine fabric for three swatches laid on a table and measured in the warp direction. One swatch was conditioned to 90 per cent R.H., then marked in 50-in. lengths at three locations in the warp direction. The humidity was then lowered to 55 per cent and a second swatch that had been taken from the same piece was conditioned and marked. Similarly, a third swatch was marked after conditioning at 20 per cent R.H. These swatches were R.H. cycled and given Hoffmann pressings indicated by the dotted lines in Fig. 16. The pressings are discussed in detail below.

The first pressing operation (Fig. 18) consisted of two fifteen-second top and bottom steamings at 65 psi. on a flat-bed Hoffmann press, with a cooling between and a glass rod passed under the fabric to aid in relaxation. In this case (Fig. 16), no shrinkage was obtained when remeasured at 90 per cent R.H.; in fact, a slight growth was indicated

for all three swatches. The second pressing, which was twice as severe as the first, also indicated a slight growth. The swatch which had initially been marked at 90 per cent R.H. seems to have approached the dimensions of the swatch marked at 55 per cent R.H. In other words, the uniform spacing of the dimensions of the fabric has not been maintained. This is believed to be due to restriction of motion from lying on the table.

The third shrinkage test consisted of successive pressing operations of thirty seconds each, terminating when the fabric moved no more. This required six pressings on the average, and an apparent shrinkage of 3 per cent was obtained. It is to be noted, however, that after putting the swatches through an R.H. cycle, practically all of the apparent shrinkage has been removed. The indicated shrinkage has been reduced to less than 1 per cent.

The last test on these fabrics was a relaxation test consisting of saturating the fabric in water at 80 to 90 F. and allowing it to drain and condition on a table. In this case, there are small inconsistencies but no shrinkage was indicated (Fig. 16). After going through an additional R.H. cycle, the measurements are essentially the same as before relaxing.

Figure 19 indicates similar data except that in this experiment the swatches were suspended from a wire rather than

¹¹ Patent Applied for, March 13, 1946, Serial No. 654,173, by H. Booth, Amalgamated Textiles Ltd.

¹² Later in the paper the authors refer to "R.H. Cycling" of fabrics. The essential characteristic of any of these cycles is that the fabric be exposed to some particular humidity level and be returned to its original R.H. At some point (starting or otherwise) in each of these various R.H. cycles, the fabric is conditioned at 90 per cent R.H.—Ed.

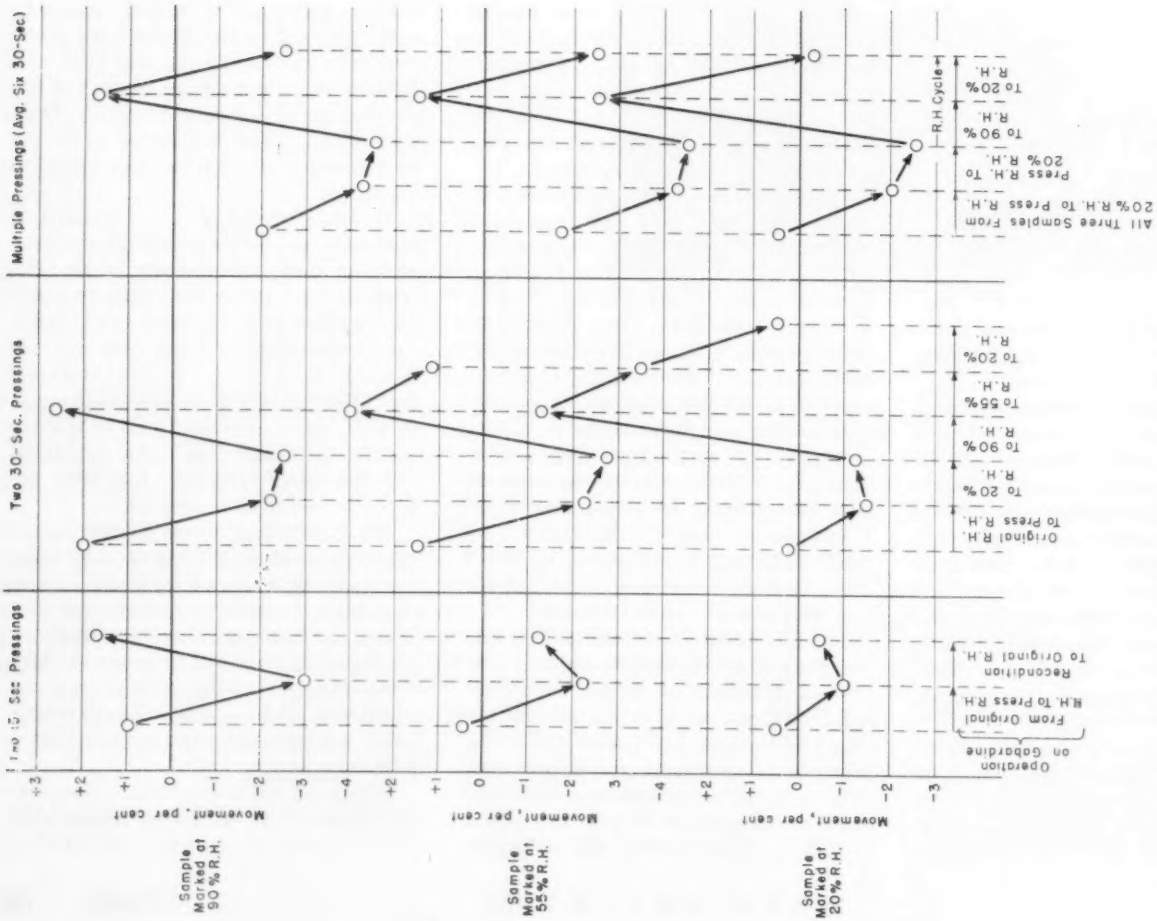


Fig. 20.—Influence of Steam Pressing on Men's Wear 12-oz. Gabardine.

Material lying flat; measured in warp direction; 70 F.

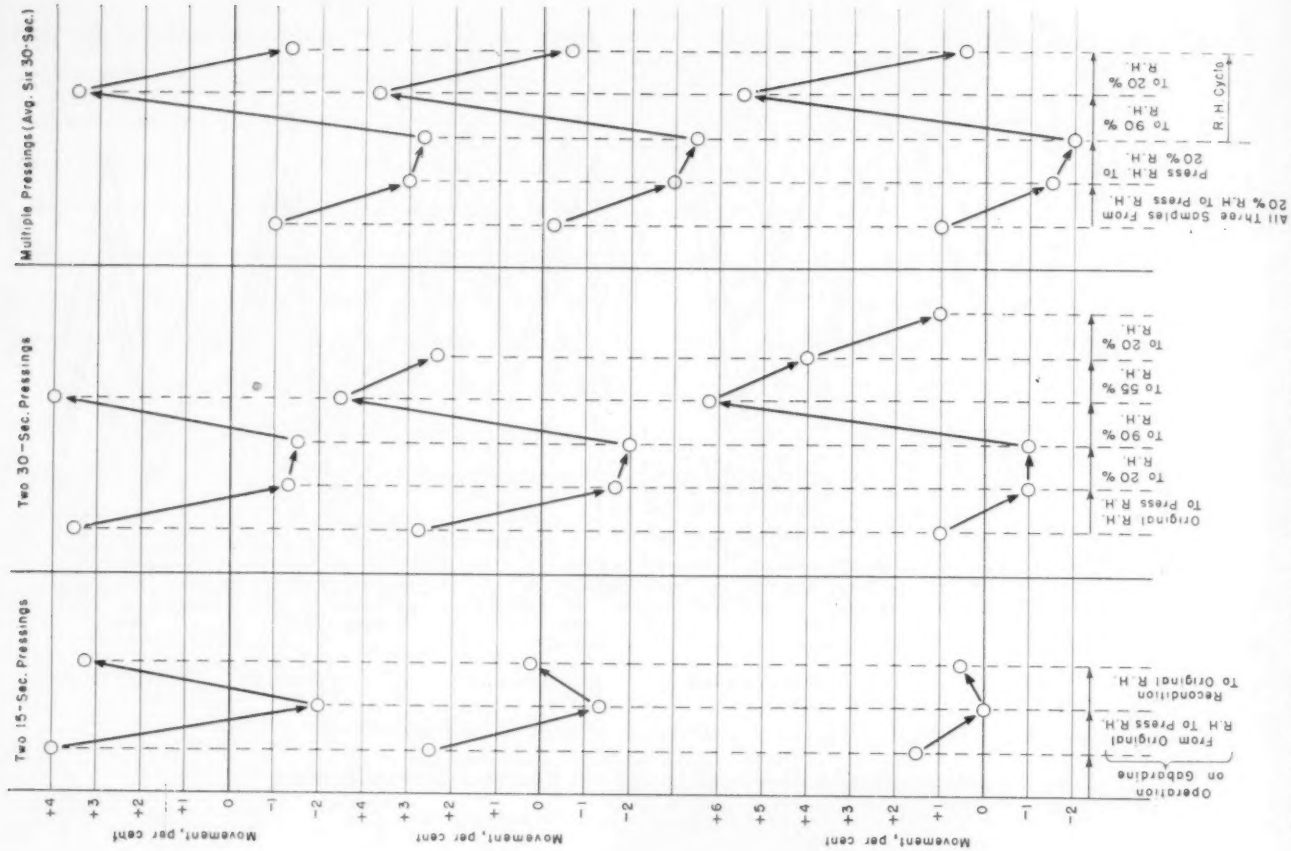


Fig. 21.—Influence of Steam Pressing on Men's Wear 12-oz. Gabardine.

Material suspended; measured in warp direction; 70 F.

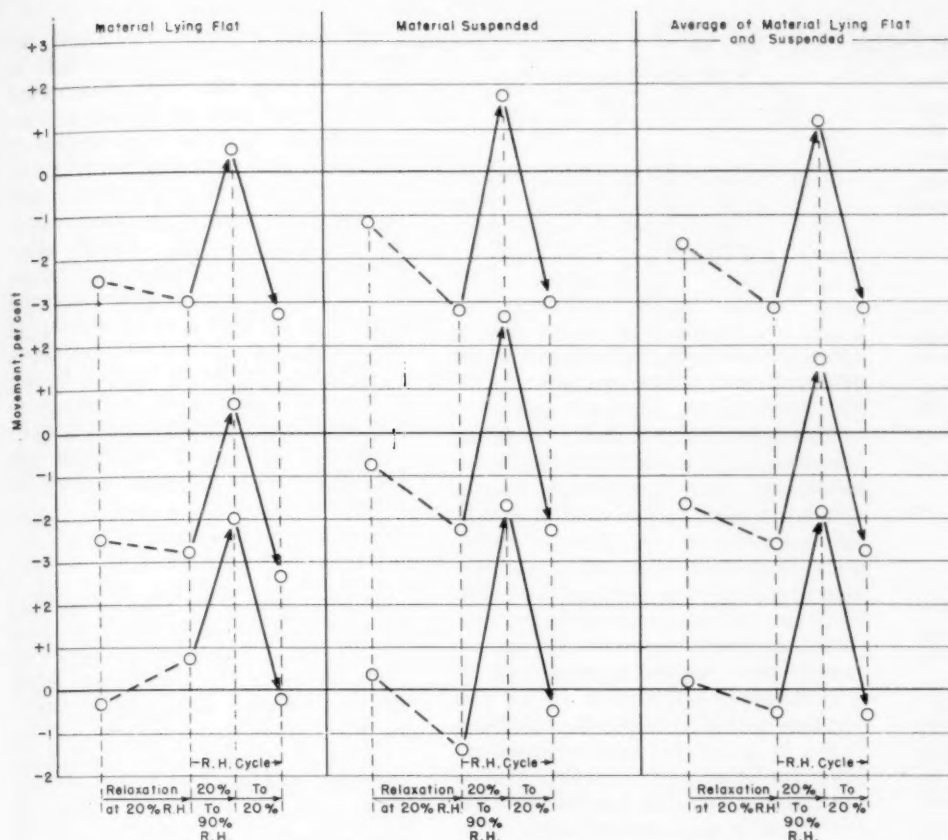


Fig. 22.—Relaxation of 12-oz. Gabardine at 70 F.

the steam time was increased to thirty seconds. This more severe steam pressing test showed no fabric shrinkage when it was reconditioned to its original humidity after going through 90 per cent R.H.

In the third pressing test series, the fabric was pressed until equilibrium was reached on the press. The motion from this test was entirely removed by going through an R.H. cycle.

In Fig. 21, information is given on the swatches which were suspended. The total movement for the swatch which had been marked at 90 per cent R.H. and measured at the press was 6 per cent. Upon returning to its original condition of 90 per cent R.H., the shrinkage indicated was only 0.7 per cent. These tests show that nearly all of the steam pressing movement can be removed by cycling through 90 per cent R.H.

In Fig. 22 data on the relaxation test have been plotted. The swatches which were placed on a table show no

cycling through 90 per cent removed practically all of this apparent shrinkage; therefore, this was not a true shrinkage or it would have been permanent to R.H. motion. On relaxation, however, some shrinkage was obtained on these swatches. This shrinkage is retained after a cycle through 90 per cent R.H. and therefore must be significant. Since no relaxation shrinkage was obtained on the swatches on the table, this was due to the strains from weight of the fabric during suspension.

In Fig. 20, details are given of the steam test shrinkage on the swatches shown in Fig. 16. The graph on the upper left-hand side shows the change in dimension of the swatch measured at 90 per cent R.H., then at the press after the pressing operation, and again after it was reconditioned to 90 per cent R.H. This swatch was originally marked at 90 per cent R.H. and showed an apparent shrinkage of 4 per cent when measured at the press. Of course, this is not a true shrinkage because when it was returned to its original moisture content the shrinkage was removed. The swatch which had been marked at 55 per cent R.H. showed an apparent shrinkage of 1.7 per cent, even after reconditioning to its original R.H. The third swatch showed a shrinkage of 1 per cent.

The second series of steam tests in Fig. 20 was the same as the first except



Fig. 23.—Fresh-Pressed Coat at 20 per cent R.H.

laid on a table. These swatches were cut from the same piece of fabric, as shown in Fig. 17. With this procedure, better consistency was obtained, particularly in the relaxation tests. The actual motion in changing from 20 to 90 per cent R.H. was greater than when the fabric was on the table. Again, the first two steam pressings show no shrinkage. Multiple steam pressing indicates 3 per cent shrinkage, but R.H.



Fig. 24.—Coat at 90 per cent R.H.

significant shrinkage; however, all three of the suspended swatches shrank approximately 1.5 per cent. This shrinkage was retained when conditioned through 90 per cent R.H. This indicates that strains existed in the fabric which were due to the weight of

the fabric during the numerous hours of cycling. The average shrinkage of the swatches on the table and those suspended are graphed in the third column.

Table I summarizes the data shown in the preceding graphs and also includes the moisture regain at the various relative humidities.

TABLE I.—EFFECT OF RELATIVE HUMIDITY ON MOTION AND MOISTURE OF 12-OZ. GABARDINE AT 70 F.

R.H. MOTION		
	20 to 90 per cent R.H.	Difference (Desorption—Sorption), 55 per cent R.H.
Avg. motion—table, per cent.....	4.4	0.5
Avg. motion—suspended per cent....	5.7	0.7
MOISTURE REGAIN		
R.H.	Regain, per cent	
20 per cent.....	5.8	
90 per cent.....	19.1	
55 per cent desorption.....	11.7	
55 per cent sorption.....	10.9	

It can be seen that the average motion of this particular gabardine from 20 to 90 per cent R.H. was 4.4 per cent, but when suspended it was 5.7 per cent. The greater motion of the suspended samples compared to those on the table may be due to either the weight of the fabric when suspended or the restriction in motion when on the table. The hysteresis effect indicated shows the difference in the dimension of the warp between desorption and sorption at 55 per cent R.H. The corresponding moisture regain of these fabrics was 11.7 per cent on desorption and 10.9 on sorption. This difference of 0.8 per cent is somewhat lower than the 2 per cent shown by Weigerink¹³ in this region. The fabric regain shown is about 2 per cent lower than the corresponding values given by Weigerink for clothing wool. It is normal for fabrics to have these lower regains.

Additional test data are shown in Table II. These tests were made on four swatches (two for test A, and two for test B) which had not previously been R.H. cycled. The effect of successive relaxation and Hoffmann steam pressing tests is illustrated in this table.

¹³ J. G. Weigerink, "The Moisture Relations of Textile Fibres at Elevated Temperatures," *Textile Research Journal*, Vol. 10, No. 9, pp. 357-371 (1940).

TABLE II.—SUCCESSIVE PRESSING AND RELAXATION TESTS.

Step	Per cent Decrease in Warp from Original 12-oz. Gabardine Conditioned to 65 per cent R.H.			
	Test A		Test B	
1..	Relaxed	5.7	Pressed	2.2
2..	Relaxed	7.2	Pressed	3.0
3..	Pressed	8.2	Relaxed	7.0
4..	Pressed	8.2	Relaxed	7.1
5..	Relaxed	7.5	Pressed	7.6
6..	Relaxed	7.2	Pressed	8.5
7..	R.H. cycled	7.6	R.H. cycled	7.0
8..	Relaxed	7.1	Relaxed	7.1

Results shown are the average of three measurements taken on each of the two swatches.

Test procedure A shows a fabric shrinkage of 7.2 per cent after the second relaxation. Due to the high amount of relaxation shrinkage, the full shrinkage was obtained only after the second water treatment. An additional 1 per cent shrinkage was obtained with two Hoffmann pressings (steps 3 and 4). This shrinkage, however, was not retained when followed by steps 5 and 6. The shrinkage obtained in step 6 was identical with that in step 2; therefore, it can be considered as the normal relaxed condition of the fabric. This is further substantiated by R.H. cycling the fabric (step 7) and relaxing again (step 8).

In test procedure B, two Hoffmann pressings (steps 1 and 2) produced an initial shrinkage of 3 per cent. When followed by water relaxation (steps 3 and 4), the shrinkage increased to 7.1 per cent which is nearly identical to the shrinkage obtained in step 2 of test A. Two Hoffmann pressings (steps 5 and 6) brought a further increase in shrinkage amounting to 1.4 per cent, but this was completely removed in steps 7 and 8. The relaxed condition obtained in step 8 is equal to that in step 4 as well as to the condition established in steps 2, 6, and 8 in test procedure A.

These data conclusively prove that Hoffmann pressing cannot be used to measure fabric shrinkage. On the other hand, water relaxation gives an accurate and reproducible measure of the fabric's normal state. It further shows that any setting action produced by Hoffmann pressing does not alter the relaxation test results.

Figure 23 shows the appearance of a freshly pressed man's gabardine suit

at 20 per cent R.H. The same coat after exposure to 90 per cent R.H. is shown in Fig. 24. The dimensional change is not obvious but the appearance change is. The R.H. motion of the fabric has been restricted by the component parts of the garment, such as, seams and tapes. The fabric cannot increase in length and takes the other alternative by growing in the third dimension, producing the apparent irregularities of puckering and bubbling at the lapels, pockets, seams, and edges. This shows the effect of fabric R.H. motion on garments when motion is restricted. The overshrinkage in Hoffmann pressing which is removed at high humidity further accentuates these irregularities.

CONCLUSION

In summary, it has been shown that changes in moisture content of wool fabrics cause dimensional changes in those fabrics. By studying fabric structures and susceptibility of fabrics to R.H. motion, indications of the changes in dimensions and the appearance change which may be encountered at high humidity in tailored garments are obtained. In addition, the study of R.H. motion in conjunction with steam test shrinkages emphasizes the inaccuracy of shrinkage test procedures. It was shown that steam test shrinkage of a fabric may give a false indication. First, it is essential that the fabric be reconditioned to its initial moisture content when making shrinkage tests to avoid including any R.H. motion in the shrinkage test. Secondly, it was shown that the steam press may overshrink a fabric—in other words, produce a shrinkage beyond the relaxation shrinkage which is not stable to R.H. cycling and, therefore, is not a true test. Since steam tests do not give reproducible results, it cannot be used as a true measure of the shrinkage of the fabric. Rather, it crudely combines R.H. motion and a partial relaxation with the introduction of temporary strains.

Acknowledgment:

The authors are grateful for the photographs made available by the Forstmann Woolen Co., Passaic, N. J., and Hugh Davis Corp., Newark, N. J.

Shrinkage Control of Viscose Rayon Fabrics¹

By J. A. Woodruff²

THE first representative of the viscose family to enter commercial use was continuous filament yarn. It was at first commonly known as artificial silk and used as a cheaper substitute. As time went on, it opened up new fabric fields where its low cost, inherent luster, and continuous length offered possibilities never before available. In very few of these textile applications was laundering shrinkage a problem. However, with the increasing availability of viscose staple in recent years, much broader apparel fields have been explored with a shift in emphasis from the novel and fragile to the tougher everyday fabrics such as shirting, suiting, and the like. These new fields of uses have emphasized the need of controlled shrinkage in laundering.

Shrinkage control means that limits are placed on the tendency of fabrics to change dimension during wet cleaning or laundering cycles (washing, drying, dampening, and pressing). All textile fabrics contain, when woven or knit, an inherent shrinkage of from 0 to 25 per cent depending upon the fibers used, the fabric construction, and the method of processing (1).³ After this processing, the fabrics which are to be used for washable garments must have a known minimum shrinkage under testing conditions representing actual use. It is logical that a dress shirt requires a smaller allowable shrinkage than would a sport shirt or suiting material.

It was fortunate for spun rayon that a great deal of work had already been in progress on the related subject of crease resistance when the need for shrinkage control became acute. The crease resistance treatments are still widely used for shrinkage control as well. However, none of the available crease resistance techniques is entirely satisfactory so far as shrinkage control is concerned, and much time and effort have been expended by chemical suppliers, as well as dyers and finishers, in the development of a new approach to shrinkage control. The reward for the most complete answer is and will be great.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

¹ Presented at a meeting of A.S.T.M. Committee D-13 on Textile Materials held in New York, N. Y. March 16, 1950.

² Textile Research Department, American Viscose Corp., Marcus Hook, Pa.

³ The boldface numbers in parentheses refer to the list of references appended to this paper.

There are many different techniques which can be used in obtaining shrinkage control. Actually, only one or two of these are now used to any extent. The advantages or disadvantages of each treatment are controversial since textile people have strongly differing opinions on relative values. For this reason, rather than to categorically state the advantages and disadvantages, a series of applicable considerations have been listed somewhat in the order of their importance when viewed from the objective of shrinkage control. They represent the desires and expectations of a converter in a request to his finisher for shrinkage control. Later, these can be considered in terms of each of the individual methods of control as desired. The considerations are:

Shrinkage control attainable,
Crease resistance obtained,
Cost of treatment,
Permanence of hand,
Possible variations of hand,
Odor,
Chlorine retention,
Effect on dye shade or other properties, and
Fabric weighting.

Of course, all but No. 6 must be judged differently with each change of class of fabric.

As an example, take a rayon marquisette in relation to No. 1. The shrinkage control desired would be defined by the results of a 105 F. wash test with a mild soap, perhaps in a home laundry machine, and for a low- to medium-quality marquisette, one would want not more than 4 to 6 per cent shrinkage in the first wash. On a high-grade marquisette, the retail price would compensate for the cost of obtaining a 2 per cent or less shrinkage in a single wash test.

Let us now consider the shrinkage desired in a women's sport suiting as a fabric requiring different treatment. In this case, there is only a small chance that the fabric will be washed, but it may be "wet cleaned." It should, therefore, have good water fastness but not necessarily laundering fastness. This is rather indefinite at the moment but 2 to 4 per cent shrinkage is apparently acceptable in a wetting, relaxed drying, moistening, and steam pressing cycle.

Finally, we come to the shrinkage control desired in the dress or fitted shirt

field. Here a 2 per cent or a ± 1.0 per cent shrinkage is taken as standard for rayon as well as cotton. This test is usually the severe Federal Specification CCCT-191a cotton wash test and if it is, there should be five tests conducted in order to show the degree of progressive shrinkage.

This gives a general idea of what is meant by the shrinkage control desired of various fabrics, and something of the tests implied.

Crease Resistance:

In the marquisette field, crease resistance is only of moderate interest. If it is secured as a by-product of the shrinkage control, so much the better. But people have long been used to starched curtains which have most inferior crease resistance. This is not the case with women's suiting where crease resistance is of greater importance than shrinkage control. In tropics, the interest is even greater, if possible. A process delivering excellent shrinkage control without maintaining an already good crease resistance or tending to improve a poor one will find little acceptance in this field of work. In general, these spun rayon suitings are entering a field long held by wool and silk, two fibers capable of being made into fabrics having good crease resistance. In the third fabric field of fitted shirtings, crease resistance is a new possibility. It is not, however, a necessary factor today. The idea of a starched cotton shirt still persists and it may take some time for this to be displaced by the desire for a luxurious, soft, resilient hand that is possible with some of the shrinkage control treatments of viscose rayon.

Cost of Treatment:

This consideration is always of primary importance and must fall within definite limits if the converter is to be able to sell such fabrics. Naturally, the margin of price range varies with the value of the fabric itself and with the increased utility or consumer desirability obtained with the finish. Costs must be judged by performance tests, as a low price finish is really expensive if it does not perform as claimed. These considerations hold true with marquisette, suiting, or fitted shirting.

Permanence of Hand:

This means the permanence or durability during normal usage or during

normal testing. The crispness of a marquisette finish is much more desirable if it can be retained with a minimum of change through three washes. The washes would be of the 105 F. type as referred to earlier. In suitings, the pleasant fullness of a crease-resistant hand should be retained through many dry cleanings and even "wet cleanings." With such a fabric, if the durability is poor, the quality of fabric is poor. Permanence of hand with a fitted shirt is not very important today. The various tastes of people have been catered to for many years by the use of sizes applied in the laundering. Also, the cutters are accustomed to a fairly constant starch finish on cotton fabrics.

Possible Variations of Hand:

The answer to this phase should be obtained during processing for shrinkage control and is certainly of importance in judging the flexibility of a finish. The hand for marquisette is usually a crisp dry one. Since the unfinished fabric is quite limp, this means that considerable stiffening material must be added. Such stiffening must not be lost through a few mild washes. If it is lost, then a crinkled or crepelike fabric results which, even with the use of curtain stretchers, will not satisfy the housewife.

Hand for women's suitings will reflect the mood of the converter, the cutter, the buyer, etc. Therefore, the finisher has to be ready to change with the wind from "slick and lustrous" to "dull and dry," "firm" to "drapey," or "raspy" to "soft"!

The hand of the fitted shirt fabric is probably more consistent but again is subject to the individual's reaction under non-standard conditions of hand appraisal and must be ready for minor changes at any time.

Odor:

It is sufficient to say that if objectionable odors occur in stored goods or garments, the finisher is likely to find himself in a very unfortunate position. He, therefore, will always lean toward finishes which are less apt to cause this trouble.

Chlorine Retention:

It is not the object of this paper to start a nonconstructive argument concerning this phenomenon. But on fabrics which are likely to be bleached with hypochlorite during their normal life, it may be rash to use a method of shrinkage control which involves the possibility of serious chlorine retention. As to what test to determine this degree of retention, considerable work has been done by a committee of the American Association of Textile Chemists and

Colorists, in an endeavor to satisfy and protect the finisher.

Effect on Dye Shade or Other Properties:

Almost all of these treatments for shrinkage control result in a change of shade of direct dyed fabrics. The finisher is very interested in how this can be avoided by dye selection and always wants it to be a minimum. The effect of the finish on the light fastness must be known. The effect on wash fastness is of interest if there is much improvement.

Fabric Weighting:

Added weight is separate from hand where the finisher is accommodating a converter so that the latter's yield of cloth weight will be high in relation to the actual fiber content. It is a dangerous practice if the loading does not last under the conditions of normal end use. Some converters have been criticized for paying too little attention to artificial and nondurable hand. There are some fabric hands, however, which cannot be obtained by construction alone and must be attained by a heavy finish.

There are several other important properties of the various finishes, such as effect on tensile strength, tear strength, and abrasion resistance. It can be taken for granted that any shrinkage control treatment must meet certain minimum requirements in each of these properties in order to qualify for commercial use. These three properties will be referred to again later.

It is hoped that the discussion of these considerations has pointed out some of the reasoning which controls a choice of finish for shrinkage control. The next step is to outline the normal methods of treatment. There are presently five classes of treatments for obtaining shrinkage control: (1) reactant, (2) bonding, (3) chemical modifiers, (4) thermosetting resins, and (5) compressive shrinkage, as set forth below:

SHRINKAGE CONTROL TECHNIQUES

Classification	Example
Reactants	Formaldehyde
Bonding	Hydroxyethyl cellulose
Chemical modifier	Alkalies
Thermosetting resin	Urea formaldehyde
Compressive shrinkage	Sanforizer

Examples of reactants would be formaldehyde and glyoxal. Bonding materials would be alkali-soluble cellulose ethers, cellulose zincates, polyvinyl alcohol, starches, gums, etc. (Only products water insoluble at the conclusion of the treatment are intended to be considered here.) Chemical modifiers refer to solutions of alkali or acid which by their action will modify the strains

and "memory" of the viscose fibers. The number of thermosetting resins used is large, but so far the field is dominated by urea-formaldehyde. Others are melamine-formaldehyde, acetone-formaldehyde, and phenol-formaldehyde. By far the best known of the compressive shrinkage techniques is the use of the sanforizer. The Redman process must also be considered. Another approach is the use of overfeed pin tenters (2).

Recalling the considerations discussed earlier in this paper, and applying them to each of the treatments listed it will be quickly seen that not one of these listed treatments will give a 100 per cent answer toward shrinkage control.

Recently, there has been a trend toward combining a reactant with a resin, a reactant with a bonding material, or a resin with a bonding material. By these combinations, it is hoped to achieve improved over-all performance—above what would be obtained with either component alone. One combination which has recently been the subject of considerable effort, is the use of alkali-soluble hydroxyethyl cellulose as a bonding material and formaldehyde as a reactant. Formaldehyde alone has long been known as an excellent reactant for use in obtaining shrinkage control but has also been known as an unpredictable reagent, difficult to control. Used alone, cellulose ether has not been very successful in shrinkage control except when such large amounts have been used that they caused excessive stiffening of the fabric. The combination and application of the hydroxyethyl cellulose and formaldehyde, with a total "add-on" of dry weight of approximately 1 per cent, brings out the good qualities of both and minimizes the faults of both. Both have excellent fastness to alkaline scouring and neither can cause chlorine retention. The usual reactant cycle of pad, dry, cure, wash, and dry is used for the combination, starting with the padding of the dyed fabric, the mixture being in an acid pad bath. Softeners have been found which can be combined with the treatment to give a very durable softened hand. Still further modifications can be obtained by mixing in silica dispersions to increase the fullness and dryness of hand.

Again, as a different combination, these same cellulose ethers can be mixed with acetone-formaldehyde resins and achieve shrinkage control which is far better than the individual contribution of either the resin or the ether used alone.

An obvious drawback of the reactant and bonding agent approach can be considered as an advantage when viewed in a different light. It is not practical

at present to increase the weight of the fabric being treated by this technique to the same extent as can be done with resins. The total weight added by the reactant plus the bonding agent is usually 1.0 per cent, with a maximum of 3 per cent, while the thermosetting resin treatments may add on from 3 to 20 per cent in weight.

One of the oldest combinations of techniques is that of resin application and compressive shrinkage. By running resin-treated fabrics on a sanforizer, a good control of initial wash-test shrinkage is obtained. But there is no guarantee that progressive shrinkage will not appear in further washings if the washings are of severe nature.

It should be understood by anyone requesting shrinkage control finishes that the three fabric properties of tensile strength, tear resistance, and abrasion resistance will be modified by nearly all finishing treatments. Those treatments falling in the class of reactants and of thermosetting resins have almost invariably resulted in decreased dry fabric abrasion resistance. It appears, in general, that this decrease is real when measured by abrading forces of laboratory magnitudes, but there is considerable doubt as to whether this same magnitude of force of abrasion is actually encountered in the end use of the fabric. There is actual evidence of improved resistance to normal wear of many treated fabric samples even though dry abrasion tests showed considerable drop in abrasion resistance. In explanation, perhaps the wet abrasion resistance has been increased by the treatment or perhaps, as has been suggested (3), the abrading forces used in the tests are extreme and will not correlate. One should not ignore this difference in abrasion resistance test figuring obtained on samples of cloth before and after treatment, rather the search should be continued for tests which will correlate with actual end-use performance of the fabric.

In contrast to the effect of reactants and resins, the bonding treatments tend to improve abrasion resistance, and this is another reason for desiring to combine the bonding treatments with the reactants or resins.

Strength and tear resistance tests are more easily correlated with actual wear than is abrasion testing. It is interesting to note that most of the shrinkage control treatments actually improve the resistance to laundering when measurements are made of tear and tensile strengths after repeated launderings. The untreated fabric deteriorates due to laundering cycles much more quickly than the treated. Some

of the treatments improve the wet tensile strength considerably, and some, by coating, seem to protect the fibers from damage.

Experimental results in the past have indicated that most techniques which cut down on the water swelling of the viscose fiber can be combined with sanforizing to give low initial wash-test figures. Special setting of the shoes on the sanforizer is often necessary since these machines were originally designed for the physical properties of cotton. Resin-treated viscose does not have exactly the same properties. The moistening unit preceding the tender frame provides sufficient wet tension so that an untreated viscose fabric would be stretched beyond the power of the sanforizer to return it to proper dimension (4). This is the reason why reduced water swelling as obtained by resin treatment, and, quite probably, some bonding as well is needed before the sanforizer can act efficiently on viscose rayon.

The action of alkali on viscose rayon fabrics for shrinkage control can give excellent wash-test results. It differs from most of the other treatments in that it causes little, if any, reduction in water swelling characteristics. There is also no appreciable change in the stress-strain curve of a fabric sample. For instance, the difference between an alkali-treated fabric and a reactant-treated fabric will be quickly seen by running a "wet-and-dry" test. Measurement marks are made along the warp of a dry sample and the change of dimension on wetting is recorded. This is followed by relaxed drying, and the dimensions are again recorded. A standard spun viscose challis, finished with an alkali treatment, lengthens on being wetted approximately 2 per cent. On drying, there is approximately 6 per cent shrinkage, with a net loss in warp dimension of 4 per cent. In comparison, a CCC-T-191a wash test would show on this same fabric from $\frac{1}{2}$ to $1\frac{1}{2}$ per cent shrinkage. A reactant-treated fabric by this test lengthens on being wetted approximately $\frac{1}{2}$ per cent and shrinks on being dried approximately $1\frac{1}{2}$ per cent, with a net loss in warp dimension of 1 per cent. In comparison, a CCC-T-191a wash test on the same fabric shows from 0 to $\frac{1}{2}$ per cent shrinkage. This wet-and-dry test is often of use in quickly obtaining indications of the stability of fabrics. The reason for the greater difference in shrinkage between the wet-and-dry test and a wash test is that with the latter, the full shrinkage possible is prevented by the action of the steam press.

But suppose that the fiber of the

treated fabric itself be treated. Many rayon staple producers have worked on the design of fibers which when made into a fabric could give shrinkage control requiring only compressive shrinkage treatment. It is felt that such fibers can be made—the method of approach which will be used eventually is not known but several approaches to fibers of changed physical properties have been seen. One recent method has been to steam treat the staple to give reduced water absorption. Another has been to apply resin treatment of the staple during manufacture. It has been shown by Cameron and Morton (5) and others that the resin treatments and the reactants all modify the stress-strain curve of viscose rayon by decreasing the normal extensibility while retaining, in general, the original tensile strength. These treatments also lower the moisture retention of the fibers. A viscose rayon fiber tailored in manufacture to have increased crystallinity, high strength, and reasonably low extensibility, gives a similar stress-strain curve as well as similar water absorption characteristics.

Following this reasoning, it is entirely possible that the shrinkage control problem may be solved by effecting changes in the physical properties of the viscose rayon staple so that compressive shrinkage of the fabric would provide, by itself, excellent shrinkage control. Perhaps, rather than by compressive shrinkage, this control may be obtained by a light crease-resistance treatment on fabrics spun from this fiber. But regardless of the final means which will be used, we have learned much from the search for shrinkage control of viscose rayons. Many avenues of approach are now possible and the finisher can select the approach which comes nearest to his own special fabric problems.

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The Dimensional Stability and Shrink-Proofing of Cotton Materials¹

By Edward C. Pfeffer, Jr.²

RATHER than to discuss the subject of controlled compressive shrinking—the process whereby cotton fabrics are mechanically shrunk to a predetermined amount in both warp and filling directions—which is pretty well known, the author discusses in this paper the subject “What happens when

imposed on the fabric during the finishing operations in caustic boiling, bleaching, tenter-drying, etc. These tensions result in an abnormal weave geometry in which the yarns of the fabric are not in a relaxed state. In particular, the warp yarns of a woven fabric generally lie in the fabric abnormally straight, with a lower than normal amount of

crimp. Figure 1, for example, was drawn from photomicrographs of cross-sections of cotton fabrics taken parallel to the warp. The top section is from a calendered, unshrunk cotton cloth. The lower section is from a washed, fully shrunk fabric. Note the pronounced difference in fabric geometry, particularly in crimp. The filling yarns may also be straightened or may be over-relaxed. For example, in cotton fabric which has been can-dried, the warp yarns have an abnormally low amount of crimp, while the filling yarns may have an excessive amount of crimp, and such a fabric when washed will shrink in the warp dimension and gain in the filling dimension. Cotton fabrics which have been tenter-dried may shrink in both warp and filling dimensions when laundered, due to tensioning of the yarns in both directions.

Swelling of the cotton fibers with water and soap solutions is also one of the primary factors in the shrinkage of cotton fabrics. Figure 2 compares the swelling of cotton and viscose rayon fibers when wet with water. While cotton fibers swell less than rayon fibers,

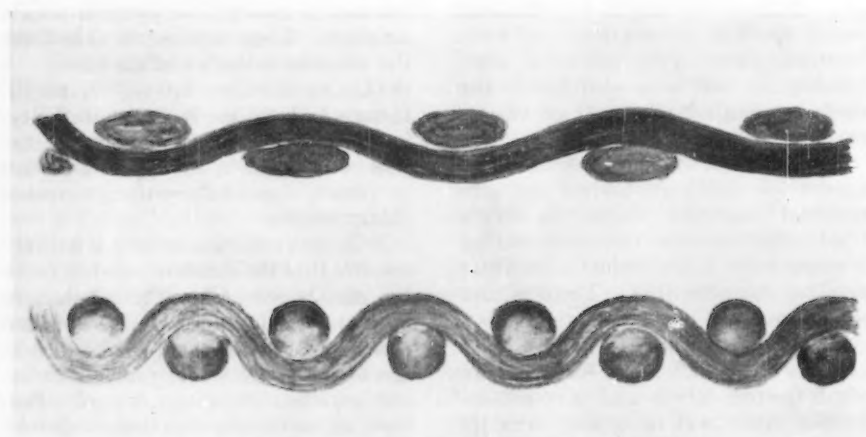


Fig. 1.—Cross-Sections of Cotton and Viscose Fabrics.
Drawn from Photomicrographs.

a woven cotton fabric shrinks?” which is possibly of more interest.

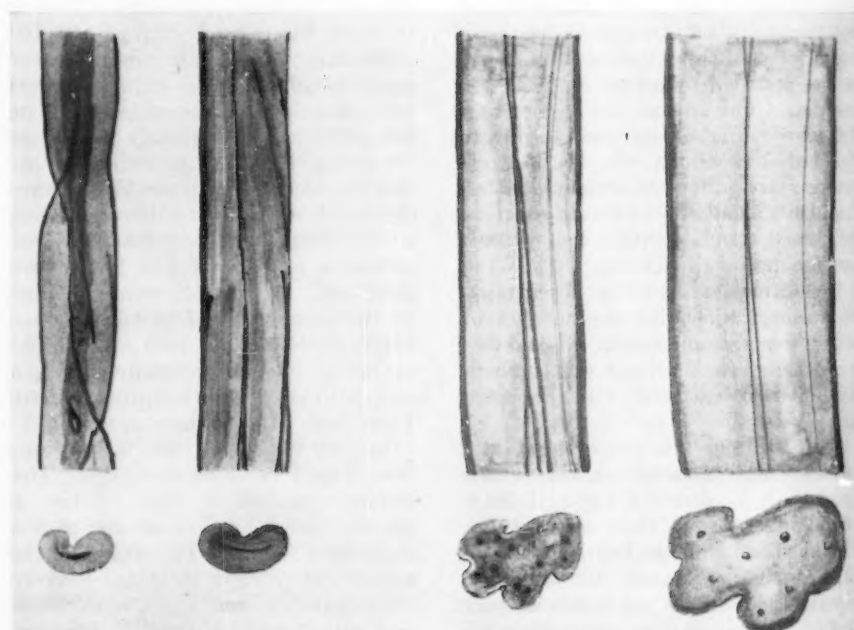
Relaxation Shrinkage:

The shrinkage in laundering of cotton fabrics that have been subjected to the normal operations of finishing without attention to shrinkage control is due to what has been termed “relaxation shrinkage.” From the technical viewpoint this is the only type of shrinkage which occurs during the laundering of cotton fabrics and it all occurs in the first laundering, except in unusual instances when the fabric is prevented from relaxing by the action of heavy sizes or durable stiffening compounds which are not entirely removed by the first laundering. Relaxation shrinkage of this type in cotton fabrics appears to be influenced by the tensions imposed on the fabric during slashing and weaving, as well as the additional tensions

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(a) Cotton.—Cross-Sectional increase = 26 per cent; diameter increase = 12 per cent.

(b) Viscose Rayon Cross-Sectional increase = 100 per cent; diameter increase = 42 per cent.

Fig. 2.—Comparison of the Swelling of Cotton and Viscose Rayon Fibers when wet by Water.

Drawn from Photomicrographs.

there is appreciable lateral swelling, as shown. It has been observed that the change in length of the individual cotton fibers caused by this swelling action is negligible, but the lateral swelling of the fibers causes the yarn itself to swell. The swollen yarns influence each other and produce crimp changes. Thus, if one set of yarns swells to a larger diameter, the crimp in the other set of yarns must increase to a greater amplitude, with resultant shrinkage of the fabric in that dimension. Fortunately the lateral swelling of cotton fibers when wet is not excessive, but this effect in combination with the softening and lubricating action of the laundering fluids permits the fabric to relieve itself of the tensions encountered in the operations of weaving, caustic boiling, bleaching, drying, etc., and to assume a relaxed configuration. Unless compensation is made for this relaxation shrinkage which occurs in cotton fabrics, garments made from such fabrics will not be dimensionally stable.

Crimp:

Crimp as referred to in the above discussion is a measure of the extra amount of either warp or filling yarn in a woven fabric required to interlace with the other set of yarns. Crimp is actually expressed in inches per yard, a fraction, or per cent, and it is determined by marking a 1-yd. measurement on a yarn as it lies in a fabric and then remeasuring these marks on the yarn after it has been removed from the fabric and subjected to sufficient tension to just remove the waviness caused by the fabric structure and to obtain the actual length of yarn lying in the 1-yd. measurements placed on the fabric. Thus, a crimp of 3 in. per yard means that 39 in. of yarn lie between two marks, 36 in. apart on the fabric.

An understanding of crimp and crimp changes is required for a complete comprehension of shrinkage problems in woven fabrics. Crimp changes occur in proportion to relaxation shrinkage in woven fabrics of cotton, rayon, or wool fibers and constitute an effective indication of exactly what happens when shrinkage occurs in woven fabrics. Since fabric shrinkage in woven fabrics always results in an increase in crimp, it becomes obvious why excessive shrink-

TABLE I.—WARP MEASUREMENTS OF COTTON FABRICS, PER CENT.

	C_1	C_2	Y	S		
				Observed	Calculated	
					$Y = 0$	Y (as is)
Before mercerizing.....	5.28	13.16	0.3 (+)	6.6	6.9	6.7
Before compressive shrinking....	5.42	9.46	0.2 (+)	3.6	3.7	3.5

age in a fabric results in its being an elastic and easily stretched fabric; yarn crimp can be removed by relatively low tensions.

Some Equations:

To answer the question as to what happens when a cotton fabric shrinks a series of tests were made. But before presenting the results, let us define:

$$S = \frac{F_1 - F_2}{F_1} \dots \dots \dots (1)$$

$$Y = \frac{L_1 - L_2}{L_1} \dots \dots \dots (2)$$

$$C_1 = \frac{L_1 - F_1}{F_1} \dots \dots \dots (3)$$

Also,

$$C_2 = \frac{L_2 - F_2}{F_2} \dots \dots \dots (4)$$

where:

C = crimp,
 L = length of yarn,
 F = fabric length,
 S = fabric shrinkage,
 Y = yarn shrinkage,
 Subscripts 1 = before wash, and
 Subscripts 2 = after wash.

From the definitions the following equations may be derived:

$$F = \frac{L}{C + 1} \dots \dots \dots (5)$$

$$L_2 = L_1(1 - Y) \dots \dots \dots (6)$$

Substitute F and L_2 values of Eqs. 5 and 6, in Eq. 1

$$S = \frac{(C_2 - C_1) + Y(C_1 + 1)}{C_2 + 1} \dots \dots \dots (7)$$

If $Y = 0$

$$S = \frac{C_2 - C_1}{C_2 + 1}$$

If $C_2 - C_1 = 0$

$$S = Y$$

Equation 7 expresses fabric shrinkage, S , in terms of crimp, C , before and after wash and yarn shrinkage. It is interesting to note from this equation that if yarn shrinkage is zero or negligible, then

fabric shrinkage is a function only of crimp. Since $(C_2 + 1)$ will be only slightly greater than 1 with moderate fabric shrinkage, the fabric shrinkage, S , will be somewhat less than the difference between final and original crimp. On the other hand, if the change in crimp is zero or negligible, then the fabric shrinkage, S , is equal to the yarn shrinkage, Y .

Results:

The experimental data shown in Table I represent a number of determinations which checked very closely with a low experimental error. Data are shown only for a cotton broadcloth shirting fabric.

The sample taken prior to mercerizing had an original crimp of 5.28 per cent; after washing it had a crimp of 13.16 per cent. The yarn shrinkage determination showed a slight gain in length of 0.3 per cent. The observed shrinkage in washing was 6.6 per cent. If we consider Y to be zero and calculate S from the simplified equation, the fabric shrinkage is 6.9 per cent. If we use Y as determined in Eq. 7, it is 6.7 per cent. A sample of fabric taken after mercerizing but before compressive shrinking showed similar results on analysis as shown, except that the shrinkage was lower. Note that in both cases the change in length of the yarns during the wash test was negligible, with a very slight gain in length rather than a shrinkage. Nevertheless, the warp shrinkages of the fabrics were 6.6 per cent and 3.6 per cent, respectively.

Summary:

These results indicate that cotton fabrics shrink almost entirely due to crimp change and not due to yarn shrinkage. It follows, therefore, that in the finishing processes the tensions exerted on the fabrics cause (1) distortion of fabric geometry and (2) unnatural crimp relationships. But these tensions do not produce significant permanent stretching of yarns.

Methods of Evaluating Aircraft Primers¹

By Edward T. Nelson²

This paper presents a brief outline of the methods used by the Douglas Aircraft Co., for evaluating aircraft primers and outlines some of the special properties of a primer that are necessary to satisfy the company's production and service requirements.

The zinc chromate primers manufactured for aircraft use must satisfy conditions greatly exceeding the requirements for primers used by other industries. Aircraft primers are used for such purposes as shop protective coatings on detail parts and sub-assemblies, insulation between dissimilar metals, general corrosion inhibition, primer coats for lacquer or enamel, and even as a final color finish in certain areas of some military aircraft. They must be capable of being applied to such materials as aluminum alloys, bare or cadmium-plated steel, magnesium alloys, and corrosion resistant steel. They must also be satisfactory for application to aluminum alloy parts and assemblies which have been hand cleaned with solvents or mild phosphoric acid cleaners as well as surfaces which have been anodized or chromodized.

Zinc chromate primer conforming to Air Force-Navy Aeronautical Specification AN-P-656³ is used for both military and commercial contracts and all primers are therefore subjected to the tests outlined in the AN-P-656 specification. Additional tests are established and performed wherever unusual properties are required such as resistance to sealing compounds, cements, and special top coats or where different application procedures are necessary, such as roller coating, spraying, dipping, etc.

It is essential that primer samples submitted by various manufacturers be thoroughly tested prior to approval for production use even though they conform to Air Force-Navy (AN) specification requirements. This is necessary because the tolerances allowed by the specification permit some materials to be formulated with properties

which might satisfy our production needs better than others.

It is assumed that primer samples submitted for test conform to the composition requirements detailed in the AN specification and a chemical analysis of such materials therefore is not conducted. Laboratory tests, however, are performed to determine physical properties, film properties, and resistance properties.

PHYSICAL PROPERTIES

Primer samples submitted by manufacturers for approval are subjected to laboratory tests to determine the physical properties of the material. Such tests are conducted as described below:

Appearance, Odor, and Skinning:

Upon opening the containers, the material is examined with a paddle for skins, lumps, and grit. The primer must be capable of being mixed to a smooth homogeneous condition both when received and after six months storage. The odor must be normal for the volatile solvents permitted in the primer by the AN specification. A 1-qt. friction top can is one quarter filled with primer, closed, and allowed to stand for 48 hr. Upon examination, the material must be entirely free from skins. Materials that require excessive straining or prolonged agitation to achieve a smooth homogeneous mixture are definitely undesirable. Also, primers that dry with a gloss finish are usually avoided because they do not offer the best surface for adhesion of top coats.

Weight Per Gallon:

A metal cup accurately machined to hold 83.2 ml. of water at 77 F. and a balance sensitive to 0.05 g. is used. Both the cup and primer are maintained at a temperature of 77 F. for this test. The cup is equipped with a lid having a small hole in the center and after weight of the empty cup and lid is determined, the cup is filled with primer, and the lid carefully put in place. When the excess material discharged through the hole in the lid is wiped off and all air bubbles are worked out of the primer, the unit is reweighed. The net weight of the material in grams which this cup will hold divided by ten gives the weight in pounds per U. S. gallon. A minimum weight of 9.8 lb. per gal. is required by

the existing primer specification. This test is used primarily as a control inasmuch as a variation between the weight per gallon of a submitted sample and production shipments of the same material in many cases reveal an error in the manufacture of the primer.

Moisture Content:

One hundred grams of primer thinned with 75 ml. of toluene are placed in a 500-ml. short-neck glass flask. A distillation trap and condenser⁴ is connected and the flask heated so that the distillate falls from the end of the condenser at the rate of 2 to 5 drops per sec. The distillation is continued at the specified rate until no water is visible on any part of the apparatus except at the bottom of the trap. This operation usually requires less than an hour. A persistent ring of condensate water in the condenser tube should be removed by increasing the rate of distillation for a few minutes. The number of milliliters of condensed water collected in the trap at room temperature is reported as the percentage of water in the primer by weight.

Settling:

This test is conducted using a 100-ml. glass-stoppered graduate cylinder having a distance of approximately 17 cm. between the 0 and the 100-ml. mark. The cylinder is filled to the 70-ml. mark with primer diluted in the proportions of 20 ml. of package material to 50 ml. of toluene. The cylinder is stoppered and allowed to stand for 4 hr. When examined after standing there shall not be more than 10 ml. of clear or cloudy-amber supernatant liquid present. After standing for 24 hr. the graduate shall be shaken, noting the length of time required to replace completely all pigment in suspension. Not more than 60 sec. of vigorous shaking shall be required. A flow-out film of yellow primer on an aluminum alloy panel immediately after the shaking shall produce a film showing no seediness or clear areas lacking yellow color. When testing darkened primer, the black color must not "float" in such a manner as to be objectionable in dip tank operation. The rate of settling and the

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² Process Engineer, Douglas Aircraft Company, Inc., Santa Monica, Calif.

³ "Primer, Zinc Chromate," Air Force-Navy Aeronautical Specification AN-P-656, August 25, 1947, Amendment 1, July 12, 1948.

⁴ "Water in Petroleum Products and Other Bituminous Materials," Method 300.14, Federal Standard Stock Catalog, Section IV, Part 5, Federal Specifications for Lubricants and Liquid Fuels; General Specification VV-L-791C, May 12, 1945, p. 117.

hardness of the settled pigment is also closely observed inasmuch as materials that might have a tendency to settle out are not considered acceptable.

Viscosity:

Viscosity is determined by use of General Electric Zahn cups, after the material has been reduced with toluene and brought to a temperature of 77 F. The No. 2 cup is used for checking material reduced 1 to 1. The No. 1 cup is used for checking material reduced to spray consistency, that is, 1 part primer to 2½ parts toluene. The readings are taken in seconds and converted to centipoises by means of a graph. Such tests are recorded and the information used to control the material while it is in production use.

Stability:

A full, closed container which has been stored for 96 hr. at 120 F. is opened and 50 ml. of the package material is placed in a glass cylinder. After 125 ml. of toluene has been quickly added to the primer in the glass cylinder, it is examined for uniformity, curdling, and precipitation. The material is checked for flocculation by flowing a small amount over a glass plate inclined at a steep angle and examining in both the wet and dry condition. The stability test is used to predict the behavior of the material when thinned for production use.

FILM PROPERTIES

Film properties and application properties are carefully checked in accordance with the procedures noted below. These properties are considered extremely important in order to avoid difficulties in production application. Panels used for such tests are cut from 75S aluminum alloy sheet and are cleaned with an alcoholic phosphoric acid cleaner which is applied to the surface with a cloth and allowed to stand for approximately 2 min. Before drying, it is removed from the surface with a cloth dampened with water.

Working Properties, Surface Appearance, and Color:

All primers must be suitable for application by brush, dip, or spray when properly reduced, and shall be a freely working product with acceptable leveling properties. After drying, the surface appearance shall be free from streaks, blisters, seeds, or other surface irregularities. Slight silking, however, is permissible provided a continuous film is produced. Color of the primer may be either yellow or interior green. When examining the yellow, the color shall be characteristic of the pigment.

Materials which develop a color noticeably greener than the yellow pigment are not acceptable. When examining the interior green, the color is visually compared with color standard No. 611.⁵

Drying Time and Stacking Test:

According to specification requirements, aircraft primers must "dry to handle" in not more than 5 min. and dry hard and tough in not more than 6 hr. In some instances this drying time may be adequate, but generally speaking too many conditions arise in the fabrication and assembly of aircraft parts where faster drying primers are required. For this reason "dry-to-handle" tests commence approximately 2 min. after application. The primer to be tested is brought to a temperature of 77 F., poured over a cleaned aluminum alloy panel, and held in a nearly vertical position in a well-ventilated room. The material is considered to have "set to touch" when a gentle pressure of the finger shows a tacky condition with none of the primer adhering to the finger when pulled away. When the maximum pressure that can be exerted between the thumb and finger does not move the film or leave a mark which cannot be removed by lightly rubbing, the film is considered dried. If rapid rubbing of the forefinger on a small area of the panel breaks the film or if the film is easily removed with the fingernail, the primer has not satisfactorily dried hard. To determine

the softening back or wetting back property (a characteristic possessed by some primers which have actually dried to touch but soften back on standing especially if under pressure), a stacking test is conducted using six 3 by 6-in., 0.032 in. gage, 75S-TAL aluminum alloy panels, which are cleaned and set in a drying rack. Four of the panels are coated on both sides and two are coated on only one side. The primer is carefully spray-applied with a horizontal pass in each direction moving the gun at a uniform rate. After exactly 5 min. drying at room temperature, the unprimed side of one of the panels is placed on a flat surface and the remaining panels stacked at right angles to the lower contacting surface so that a 3 by 3-in. portion of the panel is in contact, the last one being unprimed on the top side. A 9-lb. weight having a 3 by 3-in. flat surface is then placed on the top panel. After 24 hr. drying in this position the panels are separated by hand noting the adhesion, if any, between the primer films. Each surface is then examined to detect any impairment

⁵ "Colors, List of Standard Aircraft Camouflage," Army-Navy Aeronautical Bulletin No. 157b, August 20, 1946.

ment of the primer film. The softening- or wetting-back condition in a primer is checked to avoid the possibility of production parts sticking together after they have been primed and placed in boxes or on racks.

Flexibility:

Panels of 3 by 9 in., 0.032 in gage, 75 S-OAL aluminum alloy are used for this test. Primer is thinned to spray consistency and applied by flowing it on the panels which are held at an angle of approximately 60 deg. from horizontal. About 100 ml. of material is poured as close as possible to the top edge and allowed to flow off the bottom edge. This procedure is used to insure uniform film thickness on all panels. After drying in a nearly vertical position for 5 min. the panels are baked at 203 to 221 F. for 48 hr., then cooled to room temperature for at least 1 hr. before rapidly bending through 180 deg. over a ½-in. diameter mandrel. On one of the bend test panels a fine scratch line is made across the baked panel with a pointed stylus and the panel is bent so that the scratch mark bisects the bend. After bending, the primer film is examined for cracks and lifting at the bend under 5 to 10 × magnification and the adhesion is tested by the fingernail method. It has been found that primers that are extremely brittle as determined by the flexibility test are usually unsatisfactory when checked for adhesion and flaking.

Metal Anchorage and Coating Anchorage:

These tests are conducted on panels of 75S-TAL aluminum alloy. For metal anchorage tests, spray films are applied, air dried for 24 hr., and then examined with the fingernail or knife blade. The film shall be difficult to remove or to lift from the surface, and when scraped to bare metal with a knife blade the primer shall show a fine feathered edge free from chipping or flaking. For coating anchorage tests, a medium spray coat is applied, air dried for 1 hr., and baked at 203 to 221 F. for 4 hr. A spray coat of lacquer⁶ is then applied, air dried for 1 hr. and baked at 203 to 221 F. for 16 hr. Upon examination the lacquer film shall possess satisfactory anchorage to the primer, that is, it shall be impossible to separate the top coat from the primer coat with a knife or razor blade applied diagonally to the surface.

RESISTANCE PROPERTIES

Inasmuch as practically all aircraft aluminum alloy surfaces receive a coat

⁶ "Lacquer, Cellulose Nitrate," Army-Navy Aeronautical Specification AN-L-29a, August 21, 1947, Amendment 1, January 19, 1948.

of zinc chromate primer, it is necessary that tests be conducted to determine the primer resistance to subsequent top coats of sealants and adhesives as well as water, hydrocarbons, oils, and finishing materials. Such tests together with weather resistance and corrosion inhibition tests are conducted as described below.

Lacquer Resistance and Primer Absorption:

A medium spray coat of primer is applied to nine 75S-TAL panels and after air drying for periods of 10 min., 1, 2, 3, 4, 5, 6, 16, and 48 hr., respectively, a wet spray coat of lacquer⁶ is applied. The combination of primer and wet lacquer is examined to determine the degree of primer absorption by lightly rubbing with the finger. If the primer is completely absorbed, bare metal will be exposed, and if only partially absorbed a portion of the primer film will remain intact. Complete absorption will definitely impair adhesion of the primer to the metal surface. Poor lacquer resistance will result in bleeding and discoloration of the top coat and possibly embrittlement, lifting, or other surface irregularities.

Water and Hydrocarbon Resistance:

Panels coated with a flow-out film of primer and air-dried for 48 hr. are immersed in distilled water and in hydrocarbon.⁷ After immersion in the water for 24 hr. at room temperature, the primer is examined for evidence of checking or blistering. Two hours after removal from the water the film is

⁷ "Fluid, Hydrocarbon Standard Test," Air Force-Navy Aeronautical Specification AN-F-42 Type II, January 2, 1948, Amendment 1, September 22, 1948.

MR. W. W. ROBERTS¹ (*presented in written form*).—Dissatisfaction with Specification AN-P-656 has increased in recent years. It is an established fact that a material conforming in detail to the requirements of AN-P-656 may or may not meet present-day engineering and shop requirements of the aircraft industry. Since both the time and nature of any future changes in AN-P-656 are at present unknown, it has been necessary for the industry to find means of solving its primer problems within the framework of AN-P-656. Mr. Nelson's excellent paper, in addition to detailing some interesting test procedures, gives us an example of one workable, present-

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examined for excessive leaching, toughness, and anchorage. After 4-hr. immersion in hydrocarbon, the panels are removed and 24 hr. after removal the primer is examined for toughness, hardness, and anchorage. The immersed films are compared with the film on a similarly prepared control panel. Inasmuch as primers are used as a final finish in areas where water and hydrocarbons are likely to accumulate, resistance to such materials is considered necessary.

Weather Resistance and Corrosion Inhibition:

Panels of 75S-TAL aluminum alloy finished with a double spray coat of primer and air-dried for 48 hr. are used for the weather resistance and corrosion inhibition tests. Weather resistance is determined by exposing the primed panels for 250 hr. in a National Open-Arc Accelerated Weathering Unit, Type X-1A, employing sunshine carbons and Cordex "D" filters. To be considered satisfactory, the primer film must be intact over the complete panel when removed. Corrosion inhibition properties are determined by placing primed panels in a salt-spray cabinet for a period of 150 hr. Upon removal, the panels are examined to determine the condition of the primer film and to detect any corrosion of the underlying metal surface.

Resistance to Sealants:

After allowing a double spray coat of primer to air-dry for periods of 24 and 72 hr., respectively, parallel fillets of various sealant materials approximately $\frac{1}{16}$ in. thick, by 1 in. wide, by 9 in. long are applied with a spatula. The sealant is allowed to dry in a horizontal position at room temperature for 72 hr.,

then baked at 180 F. for 50 hr. to insure proper curing of the sealant. After cooling to room temperature, a standard flexing test consisting of three bends in each direction over a 3-in. radius is conducted at -40 F. These tests are repeated at -50, -60, and -65 F. The panels are then examined and evaluated for primer absorption by the sealant, effect of the sealant upon adhesion of primer to metal, and adhesion of sealant to primer. In most cases, parts and assemblies are primed prior to application of sealing compounds; therefore, if the primer is impaired by the compound, a poor seal is inevitable.

CONCLUSION

In conclusion, it is desired to point out that it is not within the scope of this paper to speculate on the general qualities of the existing zinc chromate primers.

It should be emphasized that in spite of the laboratory tests described, the final evaluation must await production application and service exposure. It is recognized, however, that valuable information is derived from the numerous laboratory tests which are designed to determine certain characteristics of the primer in the package condition as well as the applied film.

New tests are currently being devised to check the resistance of zinc chromate and other primers to certain nonflammable hydraulic oils, hydrogen peroxide, and other propellants, high-temperature lubricants, and general high-temperature resistance as required by modern aircraft.

Acknowledgments:

It is a pleasure to acknowledge the assistance of R. E. Donner and W. A. Stewart of the Douglas Aircraft Co. Finish Control Laboratory.

DISCUSSION

day method of dealing with the primer problem.

Mr. Nelson distinguishes between tests to demonstrate conformance to AN-P-656, and tests to demonstrate conformance to the specific engineering and shop requirements of his company. Tests to determine conformance to AN-P-656 are more or less cut and dried except for refinements in the laboratory to increase accuracy or reduce the time consumed. Tests to determine conformance to company requirements, however, are of greater interest in that they tend to point up deficiencies in AN-P-656 or special requirement peculiar to one company's shop or design practice. Examination of some of the tests discussed by Mr. Nelson but not

required by AN-P-656 therefore prove interesting.

In the section on settling properties, mention is made of "floating" of the dark pigment in tinted primer. This is a critical factor in the dip tank operation, and is not specifically controlled by AN-P-656, although some AN-P-656 primers apparently meet this requirement. If one primer meets this dip-tank requirement, why can't they all, and if they all can, why shouldn't the requirement be made a part of the AN Specification? This same line of reasoning can be applied to most of the requirements not included in the specification, but desired by most of the industry.

In the section on film properties we note that tests are carried out on 75S

aluminum alloy sheet cleaned with an alcoholic-phosphoric acid type cleaner. This makes for a realistic test in that such a combination of alloy and cleaner is probably often encountered in shop practice. It also makes a severe test in that 75S-T clad is one of the most difficult surfaces on which to obtain good primer adhesion. Specification AN-P-656 calls for making up such test panels on anodized alclad panels. Anodized alclad surfaces are practically never used in aircraft construction, so that tests carried out in this fashion have a dubious relation to any actual shop practice. Also an anodized surface will show good adhesion to very poor primers so that the test is so lenient that it loses value as a means of accepting or rejecting primers.

The section on Drying Time and Stacking Tests is interesting in that the qualities sought here are incompletely covered in the AN Specification, but extremely important in any heavy production schedule. Imagine, if you will, the situation of the paint shop foreman who has for some weeks been meeting a tight schedule on his primer line, when he suddenly finds that a new batch of primer is dry to touch in 10 min. instead of 5, and dry to stack in 4 hr. instead of 1 hr. The smooth flow of parts through his shop is completely disrupted in a matter of a few hours, and cannot be restored until he either changes his handling and storage arrangements completely, reduces his production rate, or obtains again the primer around which his system was built. Here again, it is obvious that some primers meet the requirement and some do not. Why should not they all?

We note with interest that the finger-nail test for adhesion and hardness seems to remain popular, in spite of some of the newer tests now available. There may be some who feel that this old standby is outmoded, but its value should not be lightly discounted. As a rough, rapid means of saying "good" or "bad" it is without peer. For a straight acceptance-rejection test it is possible to substitute innumerable more expensive and time-consuming tests, for a questionable increase in the validity of the results. The "calibrated thumb-nail" will probably be with us for some time to come as a tool for rapid, subjective evaluation of hardness and adhesion.

Mr. Nelson lists tests for resistance to lacquer, water, hydrocarbons, weather, etc. Process Engineers at Boeing are convinced by recent experience that exposure to 95-100 per cent relative humidity at temperatures from 95 to 120 F. will be an increasingly valuable

tool in evaluating not only primers, both production and experimental, but also the efficiency of various methods of surface preparation. Early test programs with this tool have already given startling confirmation to hitherto only suspected facts about the influence of cleaning methods, alloys, and types of primer on primer adhesion. It is felt that the results of this type of testing will predict to some extent the long-time service behavior of various primer and finish systems. Final evaluation of the test method waits on correlation of test data with service experiences.

In conclusion, it should be noted by all concerned that while primer is manufactured to meet the requirements of specifications AN-P-656, it is purchased by most major aircraft companies to meet specifications AN-P-656 and some additional company requirements. These additional requirements are usually recognized in a company procurement specification of some kind, an approved source-buying policy, or both. In any event the primer that meets the requirements of specifications AN-P-656, but not those of "X Airplane Co." is not purchased by that company. Now, airframe manufacture in different plants has much in common, including several of the extra-AN requirements on primer. Wouldn't it be better for all concerned if, through a cooperative program, a specification could be written that would enable the paint formulator, by following a definite series of tests, to determine that he had a product acceptable not only to the Government, but to the majority of the airframe manufacturers as well?

AIR MATERIEL COMMAND² (presented in written form).—Much of the initial work on the development of zinc chromate primers leading to the issuance of Air Corps Specification 14080 dated June, 1936, and later incorporated into ANA Specification AN-TT-P-656 was conducted at Wright Field, Dayton, Ohio. However, after the release of the latter specification, the Navy Bureau of Aeronautics was assigned the responsibility for qualification testing of primers for conformance to specification requirements. For the past several years, the source of Air Force information on primers has been mainly from reviewing of reports issued by the Bureau of Aeronautics and aircraft manufacturers, coordination of specifications, contacts with paint manufacturers, published literature, and only a limited amount of laboratory evaluation of specific primers to determine the cause of difficulties encountered in production and service

² Dayton, Ohio.

use. Therefore, the USAF, Air Materiel Command, has little to comment concerning the specific appropriateness of the test methods presented and the 75 acceptable primers listed in ANA Bulletin 103e.

The tests discussed by Mr. Nelson are, in general, very similar to those given in Specification AN-P-656 for zinc chromate primer for aircraft use. Apparently the major differences are the use of 75S aluminum alloy sheet test specimens instead of 24S-T and substitution of 250-hr. accelerated weathering test and 150-hr. salt spray test for Weather Resistance (Durability) which has already been completed on all primers listed in ANA Bulletin 103. The addition of a new resistance-to-sealants test is very appropriate for inclusion in an aircraft company evaluation of primers for use in production since it is a specific requirement that must be met. The inclusion of such test in a general specification would be difficult due to the varied type of sealants which might be used, and, furthermore, a number of otherwise suitable primers would be eliminated from general use where the special condition would not be encountered.

The tests reported are conducted in a given laboratory and therefore would be standardized. However, for an outsider, a few questions arise. More specific information concerning the film thickness of a "medium spray" and "double spray" coat of primer would be desirable since Air Materiel Command experience indicates that these terms are used in industry to describe application of primer films varying in thickness from 0.2 to 2.0 or more mils which certainly would result in varied answers. Also, possible Government specifications covering the accelerated weathering and salt spray tests and information concerning correlation of the hours of exposure in each test to months of weather durability under service conditions would be welcome.

An industry evaluation of a primer for use in their production line often gives additional emphasis to other workmanship and resistance factors than previously mentioned. The drying time required for the primer prior to application of top coats, resistance to stripping off with masking tape as used in applying insignia markings, resistance to moisture and high humidity conditions, and dip tank stability after a long period in use are a few properties given special consideration as they relate to the cost of production.

The Air Materiel Command is especially interested in the concluding remarks stating that new tests are being devised to determine the resistance of

primers to certain nonflammable hydraulic fluids, rocket propellants, new high-temperature lubricants, and general high-temperature resistance as required in aircraft of the present and future. The Air Materiel Command desires any information on such suitable tests as well as the answers to these various problems.

MR. A. M. MALLOY^{3*} (*presented in written form*).—The author of this paper has shown a clear understanding of the methods currently employed for testing high-quality aircraft primers. The introduction of additional tests covering properties of specific interest to Douglas because of local production requirements, for example, resistance to sealants, stacking ability, and the use of alcohol-phosphoric acid treated panels in lieu of anodized panels, is noted with special interest. With regard to another item of local concern—the dip-tank stability of primers—since application of the bulk of the primer at Naval installations is performed by spray, the dip-tank stability is at present of only minor interest to the Service. This factor cannot be taken into account in specification AN-P-656 because of the variables associated with dip-tank operations—drag-out, solvent loss, unanticipated shut-downs in the plant, etc. In the case of specification AN-P-656a this would introduce a requirement incompatible with the composition of this material. The AN-P-656a primer fills a need currently recognized to be of major importance at overhaul stations; *i.e.* adhesion under adverse painting conditions. However, imposition of the additional requirement in the procurement of AN-P-656a primer by aircraft contractors, if possible would not be precluded. The introduction by the author of a lacquer resistance test is considered an important contribution, but the value of this test would be enhanced if it were of a more quantitative nature. With respect to the coating anchorage test, since in current aircraft painting practice the primer is generally top-coated after a relatively short air-drying period, it is advisable to test the coating anchorage of lacquer over the air-dried primer rather than over baked primer.

Another production problem which is worthy of comment at this time involves determination of the moisture-sensitivity of the material. A wave of paint failures was recently experienced at a Naval air station due to peeling of

³ U. S. Navy, Bureau of Aeronautics, Washington, D. C.

* The opinions expressed herein are those of the writer and are not necessarily official opinions of the Bureau of Aeronautics or the Department of the Navy.

the paint upon removal of masking tape during application of the national aircraft insignia. A test was devised involving an overnight cycle in a humidity cabinet at 100 per cent relative humidity and 120 F. and application of a piece of UU-T-106 masking tape, followed by determination of the resistance to removal of the complete primer plus lacquer finish when the tape is abruptly removed. Consideration is at present being given to inclusion of this test in the specification for primer, AN-P-656a. (A similar test has already been included in the Bureau of Aeronautics lacquer specification 52L26(Aer) to evaluate the moisture-sensitivity of top coat materials.) Inasmuch as aircraft are overhauled from five to ten times by the Service as compared with a single processing through an aircraft contractor's plant, and further, since it is obviously impracticable to cover many of the additional requirements due to variations in the practice of individual aircraft production plants, the military specification must, of necessity, be the best all-around procurement document, with differences resolved in favor of the needs of overhaul stations.

Mr. Nelson has built his case around specification AN-P-656, which has since been superseded by the 656a version, which covers an improved material, of high dispersion resin content. Accordingly, differences between the Douglas test procedures and those presently employed by the Bureau of Aeronautics are here discussed with the circumstance in mind that this paper was written before the new specification was issued. Although the author has described tests of film properties, resistance, and corrosion inhibition conducted with films applied on 75S aluminum alloy, it should be noted that the revised specification, AN-P-656a, prescribes tests on clad aluminum alloy, in order to judge the performance of the primer on the material employed predominantly in the fabrication of aircraft at the present time. Since the exteriors of Navy aircraft are being produced primarily from clad 24S, clad 75S, clad 14S, magnesium and stainless steel, any adhesion work must take all these materials, and some others, into consideration.

The determination of paint adhesion with the thumbnail is now recognized to be an inferior test procedure and the Bureau of Aeronautics has therefore concentrated on quantitative adhesion tests; for example, with the Interchemical adherometer, in development work on coatings. It is anticipated that the instrument will also prove of value in spot checking inspection samples. Adhesion is characterized in this test by

a number, expressed in dynes per millimeter, rather than the relative ease of removal with a fingernail (of indefinite rigidity and propelled by a force which varies with the physical well-being and personality characteristics of individual operators). A crying need still exists for relating the composition of the wet paint, as evidenced by some specific property such as surface tension, heat of wetting, or some other as yet unknown factor, to the resultant adhesion on metal.

The writer advances the thought that specifications should be written in a manner which will describe a material that meets the needs of aircraft painting operations rather than merely to describe a type of material because it is available. It is recognized, of course, that the specification requirements describing the material must be compatible with practicability.

In conclusion, since AN-P-656a primer was originally designed specifically for aluminum alloys and is used on other metals such as magnesium alloys purely in the interests of production efficiency, the need for other primers specifically inhibitive to magnesium and with better adhesion, has long been recognized. Such a primer is under active development by the Bureau of Aeronautics, and it is hoped a new primer may eventually result, which will supersede the current AN-P-656a primer and possibly provide improved performance on both aluminum and magnesium alloys. In this connection, in view of the need for a universal primer for use on such diverse aircraft structural materials as magnesium, steel, aluminum alloy, clad aluminum alloy, and fiber glass to satisfy the requirements of accelerated production and overhaul schedules, tests of the Bakelite Corp's. WP-1 wash primer as the initial treatment for all the above materials are currently under way. It is emphasized, however, that the above investigation is exploratory and does not indicate acceptability of the material. In passing, it is noted that the use of the term primer for the latter material is unfortunate since it is more properly a surface treatment, and its ultimate effectiveness, as in the case of most surface treatments, is only realized by subsequent application of a true primer coating.

MR. E. T. NELSON (*author*).—Mr. Malloy in his discussion refers to the need for using clad aluminum alloys in making the tests. Clad 75S Aluminum Alloys were used for the primer tests as indicated by 75S-TAL and 75S-OAL. The AL part of the 75S-TAL or 75S-OAL designation indicates aluminum clad material.

BOOK REVIEWS...

Acoustical Designing in Architecture

Vern O. Knudsen and Cyril M. Harris have performed a meritorious service to architects, engineers, physicists, psychologists, and others interested in the acoustic problems of buildings by presenting inside the covers of a 450-page book an authoritative account of the current status of architectural acoustics.

There is some meat in this book for everyone. Acousticians will find extremely useful the complete tables of sound absorption and sound insulation data, the many tables and charts giving quantitative data on such diverse topics as peak sound power outputs, statistical distribution of hearing impairment among the population, average noise spectrums, loudness computing charts, sound spectrograms, Federal specifications for acoustic materials, mounting of acoustic materials, special sound absorbers, normal modes, sound attenuation coefficients in air, optimum reverberation times, average noise level data, recommended average noise levels, impact noise reduction, machinery noise isolation, acoustical filters, noise control, etc. Architects will find much that is valuable in this book. While it is relatively free of mathematics at all times the authors strive to present the basic picture of the actual phenomena taking place, from the story of what goes on in the individuals who have to hear and understand their auditory environment to the effects introduced by the sound-transmitting medium, whether in open or closed spaces. Some six chapters are devoted to a detailed discussion of the application of acoustic principles in the design of auditoriums, school buildings, commercial and public buildings, homes, apartments, hotels, churches, and radio, television, and sound studios. In addition, there are several chapters devoted to the principles of noise control. Heating and ventilating engineers will find the chapter on controlling noise in ventilating systems adequately supplied with quantitative data. City planning commissions will find of interest the recommendations for siting and planning against noise.

This book brings to mind a topic of some interest to the members of the American Society for Testing Materials, that is, the question of noise level standards, or rather the absence of them. No American standardization organization has yet attempted to formulate standards of maximum acceptable noise levels for different types of buildings and living areas, or minimum standards of sound insulation required for building structures and components. In this book, acceptable noise levels are indicated by the authors on the basis of their extensive experience. In addition, they quote noise level standards such as have been promulgated in foreign countries, notably

Sweden. There seems to be a real and urgent need for standardization of this type to be undertaken here in the U.S.A. so that adequate noise level provisions could be provided in local building codes.

There are a few things which the reviewer was not able to find in the book which properly might have been included. One of these is a specific design for a sound-deadened and sound-insulated room to be used for auditory diagnostic work. This type of problem is one which often crosses the reviewer's desk. As a general reaction, I believe, the architect would probably have preferred many more specific acoustic designs of various buildings. I looked for a discussion of sound-absorbent, doorless telephone booths. With regard to the effect of inserting an absorptive blanket in the airspace of a double wall, a practice which the authors recommend for structurally isolated double walls, we have found at the National Bureau of Standards that in the case where the walls are moderately massive no more than about 3 decibels improvement can be obtained. Hence, the use of an absorptive blanket in this case has been considered uneconomical from the viewpoint of the cost of such a relatively small improvement. I found the caption "Relative Noise Level in Decibels" in Table 12.4 misleading. In the case of the isolation of machinery vibration the authors give detailed design charts and data for isolating against these low-frequency disturbances. The reviewer has usually found it advisable to point out that a properly designed conventional vibration mount usually eliminates disturbances due to the fundamental disturbing frequency of the machinery. Often, however, there exist, in addition, disturbing vibrations in the audio-frequency range. To reduce these, it is usually necessary to fasten the vibration mount on a plate or floor construction which is isolated from the main structural floor by a pad or blanket of resilient material, such as cork, rock wool, glass wool, etc.

These are minor criticisms, however. The reviewer recommends this book most highly. It is extremely useful, for during the short time it has been in my possession it has been tested against the many inquiries received here at the National Bureau of Standards and in each case a suitable answer was found in the book.

ALBERT LONDON

Sound Absorbing Materials

THERE has been considerable theoretical work on sound absorptive materials reported in various journals during the past dozen years, resulting in the need for a book which would bring such information together. Hence this new book by C. Zwicker and C. W. Kosten will be welcomed by researchers in the field of sound absorptive materials, designers of such products, and development engineers in the acoustical materials industry.

The first three chapters of this book are

concerned with the theory of sound absorption in acoustical materials. The treatment of the theory is lucid, and is supplemented, where needed, by experimental data. Mechanical factors such as porosity, compliance, and flow resistance are related to the acoustical impedance of porous materials. Chapter 4 is devoted to methods of determining these constants experimentally. Several methods of acoustical impedance measurement are given in Chapter 5. Chapters 4 and 5 do not cover all possible methods—rather the authors present a few selected ones. For example, one of these, which can be applied to measurements of acoustical materials on a wall, is a very clever method and probably has not been described elsewhere in publications written in English; the complex impedance of the material is indicated directly on the screen of a cathode-ray oscilloscope.

Chapter 6 describes some experimental results, including interesting data for several artificial samples of acoustical materials prepared from glass tubes. Data such as these provide experimental results which are particularly useful in checking theory. Chapter 7 presents a comprehensive discussion of the theory of acoustic resonators. Design charts are given for panel absorbers which are perforated by holes or by slots. The first seven chapters are confined to the absorption of sound at normal incidence. Unfortunately the treatment of theory for oblique and random incidence given in Chapter 8 is not as comprehensive as the previous chapters. The book carries a large number of references in the footnotes, the greater percentage being to European researches.

Copies of this 171-page publication can be obtained from the publishers, the Elsevier Publishing Co., Inc., New York, N. Y., at \$3.

CYRIL M. HARRIS

New Research Laboratories

ON JUNE 8, 1950 in Skokie, Ill., the Portland Cement Association dedicated their new research and development laboratories. J. G. Morrow, President of the American Society for Testing Materials, attended the ceremonies which were followed by a buffet luncheon and an inspection tour of the laboratories.

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